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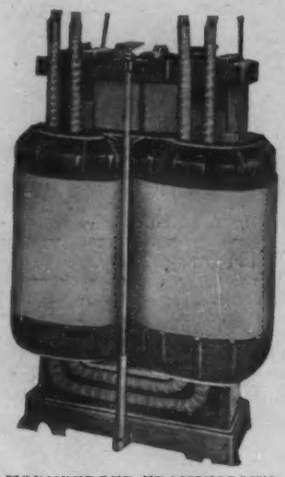

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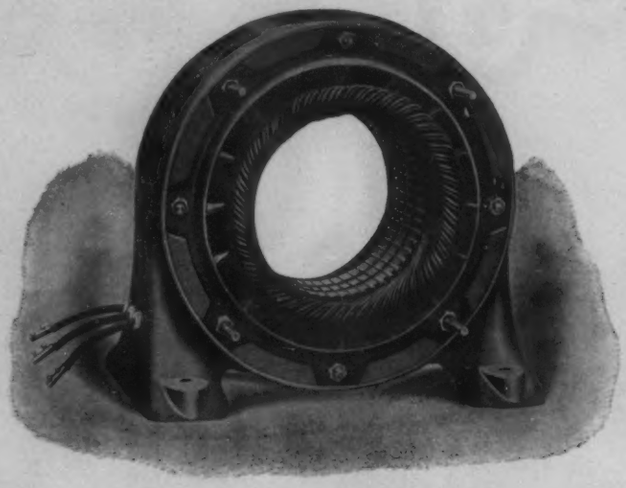

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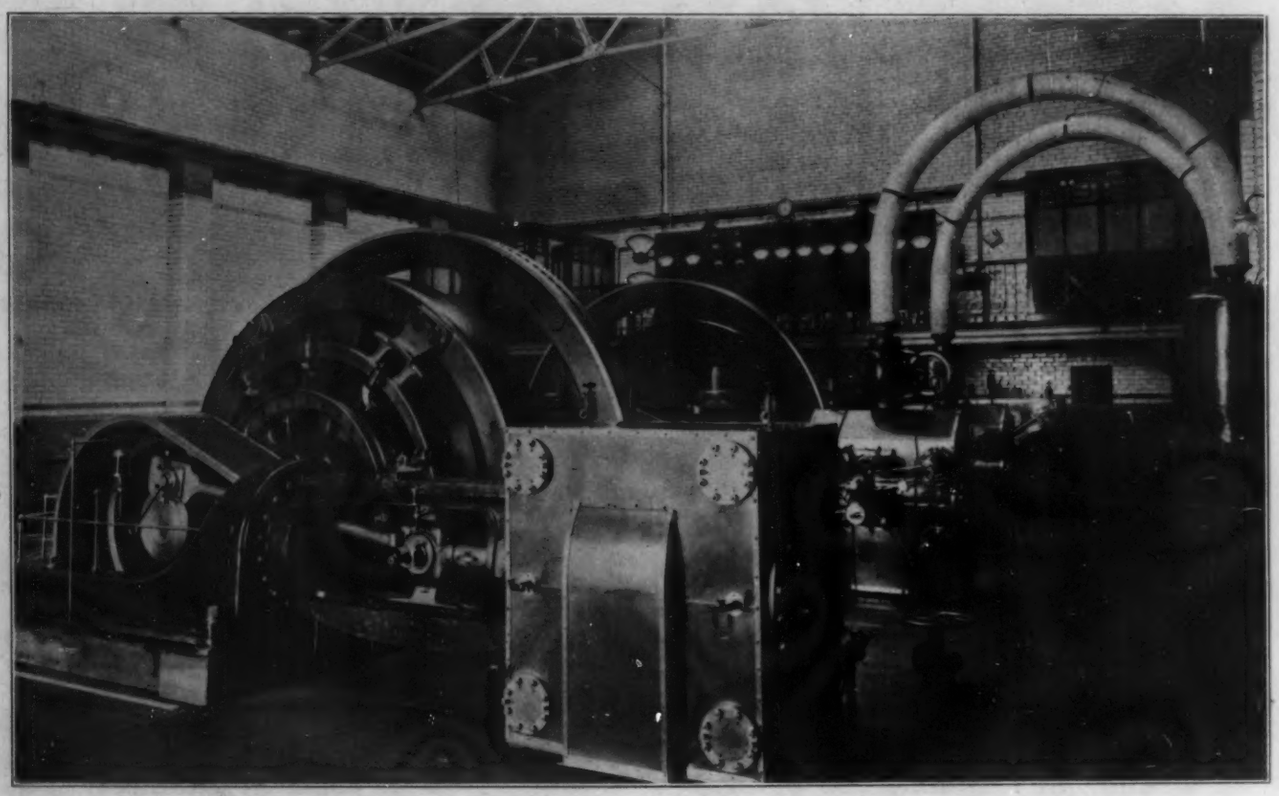
ELECTRIC LIGHTING AND RAILWAY SERVICE WITH CITY REFUSE

The accompanying illustration shows the Fulham Electric Works at London, S. W., where a refuse destructor is employed and the power utilized for driving electric lighting sets, the clinker being made into paving stone and slabs as shown in the illustration. At this plant 145.6 indicated horsepower hours are obtained per ton of refuse, with 120 tons destroyed per day of twenty-four hours in the twelve destructor cells of the back-to-back top-feed type employed. The boiler equipment consists of a half-dozen water tube boilers of the Babcock & Wilcox type, together with economizers and steam blowers for force draft.



PRESTON ELECTRIC RAILWAY POWER HOUSE SUPPLIED WITH STEAM FROM MELDRUM REFUSE DESTRUCTOR PLANT

Municipal authorities throughout the world have been making a careful study during the past decade of the question of how best to deal with the refuse of their various communities, and in these days of inventive genius and general development of labor-saving devices there has been wonderful municipal progress along these lines. The treatment of waste matter of cities and towns is now considered not wholly an expense, since the systematic and scientific burning of such refuse may make it a valuable asset in the generation of steam for the production of electric current for lighting the streets and public buildings as well as for power for electric traction.

Such scientific treatment of waste refuse not only secures more healthful and sanitary conditions for the inhabitants, but it may also be utilized in addition to the above service for supplying power for pumping water and sewage, while the cinders as by-product are utilized to advantage for pavement slabs, bricks, mortar, and the balance for concrete.

Until recently in most places the open tip was the usual receptacle for refuse and it was allowed to lie exposed to the varying atmospheric conditions of the climate, the hot sun beating upon it during the day, causing offensive odors to rise in the evening. Undoubtedly this has been responsible for many diseases. The introduction of the destruction of refuse by fire has entirely obviated these difficulties wherever used.

More than two decades ago the city of Preston, England, installed its first refuse destructor, consisting of a row of eight cells of the top-feed variety with natural draft and this equipment served its purpose for several years when a second refuse destructor plant was installed, consisting of

twenty cells of the same kind of the Manlove, Alliot & Fryer type. These were placed back-to-back and fitted with a Jones' fume cremator, and the combined plants handled the city's refuse collection for another decade, when it was found that they could not cope with the whole output. The scavenging committee, being unwilling to resort to tipping, visited many operating destructor plants, paying particular attention to thorough cremation and methods of feeding.

The new refuse destructor decided upon was of the front-feed type, the authorities maintaining that the top-feed isolated cells were responsible for the emission from the chimney of unconsumed vapors and for varying temperatures taking place in the furnace chambers. They were also impressed with the intense heat developed in the process of cremation and with the power which it was possible to produce with the front-feed grate system of destructor.

The electrification of the Preston street railways was under consideration, and after conferences between the scavenging and tramway committees of that English city it was decided to erect the two stations side by side in order to utilize the steam power generated by the refuse destructor for electric traction.

The wisdom of this decision has been demonstrated by the successful operation of the Preston electric tramways with power generated by the destruction of the town's refuse in an up-to-date destructor plant.

The destructor installation includes four Meldrum regenerative furnaces of the four-grate simplex type, each unit having a total grate area of one hundred square feet, the plant being so arranged that any pair of the units can work together with special attention being paid to cleanliness, convenience of operation and the saving of labor.

As the carts of refuse arrive at the destructor plant they are backed against a long tipping sill and shoot their loads of refuse into four steel hoppers, each having a capacity of forty tons and thoroughly protected from the weather.

The refuse handled by this plant differs greatly from that of American cities, where the wet garbage and refuse is usually kept separate from the dry rubbish such as paper, rags, ashes and wood. At the Preston destructor plant the refuse is of a miscellaneous character, consisting of dry and wet ashes with a sprinkling of excreta, offal, both animal and fish, together with condemned meat, game and poultry. About twenty thousand tons of refuse is disposed of per year, or an average of fifty-five tons per day, and this does not include about twelve tons of fish, offal and nine carcasses per week, including horses, cows, sheep, pigs and calves.

It is remarkable that this destructor, while operating the electric street railways of this English city, at the same time cremates these carcasses, utilizing even this material for generating power, while the residual, amounting to thirty per cent and consisting of excellent hard clinker, is found especially suitable for road foundation and other municipal purposes and provides a considerable source of income.

After passing the tipping platform and entering the destructor, a wide corridor is noted, on one side of which is located the outlet of the hoppers, and on the other side the furnaces. A stone still is provided on which the refuse falls from the hoppers, and it is charged by the fireman by hand through the front doors of the furnace, the fire being regulated to suit the material. The authorities at Preston advocate the hand feed as the most satisfactory, claiming that it combines efficiency and economy with a most perfect combustion of the material and an avoidance of all disagreeable odors.

There is a large furnace chamber covered with one continuous arch with the simplex arrangement of grates, and on looking into the furnace it appears to be one length of fire bars with four door openings at the front, while it is in reality divided into four compartments by brick walls carrying inverted C. I. Tees with their edges level with the surface of the fire bars.

Each compartment of the ash pit contains separate force draft accessories, consisting of steam jet blowers and the gases of combustion traverse the furnace in the direction of its length.

The burning gases leave at one end through an arched opening in the wall dividing the furnace and combustion chamber, most of the dust settling in the latter, while the gases are drawn to the boiler outlets lying at the further end of the chamber.

It is claimed that there is an absolute cremation of all noxious vapors, it being difficult most of the time to ascertain from the appearance of the chimney whether the plant is in operation or not. It is held that this absolute cremation of the refuse is insured by the continual mixing of the gases in the furnace and combustion chamber while they are subjected to the radiant heat of the brick work, maintained in an incandescent state.

At the Preston refuse destructor plant two of the four units are provided with an offal hearth, and the gangway is at a convenient level from the tipping platform, serving the purpose of unloading butcher's offal and fish, this being dumped down a brick-lined tube on a concave hearth. It is exposed to the fire and the gases that are given off must necessarily pass over the whole length of the fire grate and are entirely consumed. In this way the carcass of a horse may be disposed of without in any way impeding the efficiency of the destructor, every part being cremated, even the bones aiding in the generating of steam and only the horseshoes and nails being found in the clinker. The whole carcass is dealt with without handling, as the two other units have an electrical opening in the top of the combustion chamber and mechanical equipment is provided for handling these heavy weights. The Board of Agriculture requirements makes is necessary that the destructor furnaces deal with whole carcasses of animals affected by such diseases as anthrax and glander. It is unnecessary for a man to approach the opening in the furnace, as the carcass is lifted directly from the cart by a traveling trolley operated at the platform end with a device for releasing the carcass below the opening of the furnace.

Having considered the destructor furnaces of the Preston plant, it may be of interest to consider the construction of the boiler engine and electrical generator installation. There are four boilers of the Lancashire type, and the gases after leaving the combustion chamber pass into these boilers, having reached the heat of about 2000 degrees F. The boilers are eight feet in diameter and thirty feet long, and are designed for a working pressure of 200 pounds per square inch. They are each connected to the combustion chamber by means of three steel tubes lined with fire brick, and the gases pass through the boiler in the same manner as in a coal-fired boiler. It is maintained, however, that the temperature is more constant than with a coal fire, and consequently there is less fluctuation in the steam pressure of the boiler, which is very desirable at an electric power station. It is stated that the constant high temperature in this type of destructor furnaces is attributed to the fact that only one portion of the grate is being charged or being cleaned at a given time, the others being in an incandescent state, thus insuring the rapid ignition of each fresh charge. This evenly high temperature insures a high evaporative duty in the boiler without in any way sacrificing the perfect destruction of the refuse.

One of the most interesting features of this Preston destructor plant is the regenerator through which the gases pass after leaving the boiler, and consisting of a nest of pipes. The air for combustion is drawn into the ash pit at a temperature of 400 degrees F., becoming heated by circulating around these hot tubes. There is no question but that there is great value in the utilization of the hot gases

coming from the boiler in this manner when consuming waste refuse which is a fuel of low calorific value.

As a dust catcher the regenerator is said to have proven very efficient, the dust which passes through the boiler flues being trapped and deposited beneath the tubes in the pit.

It is advantageous where continuous power is necessary for electric street railway and other similar service that duplicate flues be provided for the gases passing from the regenerator so that the plant may be worked without interruption, and at Preston a complete duplicate plant has been installed. Green economizers are employed arranged in three groups, eight pipes wide, with 288 pipes altogether. An engine is provided for operating the scrapers. The economizers are only utilized on heavy loads, a by-pass flue being provided, while there is a damper to shut off the entire plant if required, there being a special locking gear on the dampers which renders it impossible for the pull of the chimney to close any of them.

The sanitary department has nothing whatever to do with the electricity department of the city of Preston, and the former, having generated the steam at the destructor station, sells it to the electric tramway department of the municipality.

It will be noted that the city refuse in its destruction is very advantageously used for supplying steam for operating the electric railway, horizontal cross-compound engines being used, each having a maximum output of 520 horsepower. While this plant was under construction, it was maintained by many that sufficient power could not be obtained for operating the railway, but it may be stated that the Preston refuse destructor supplies the tramway department with sufficient steam to generate 20,000 units a week.

This was found to be sufficient to operate the Preston electric tramways over ten miles of streets, with a length of track of sixteeen and one-half miles. Electric power is also supplied from this waste refuse for lighting the car sheds and workshops as well as the destructor buildings and also supply steam for a large Jeffries disinfector.

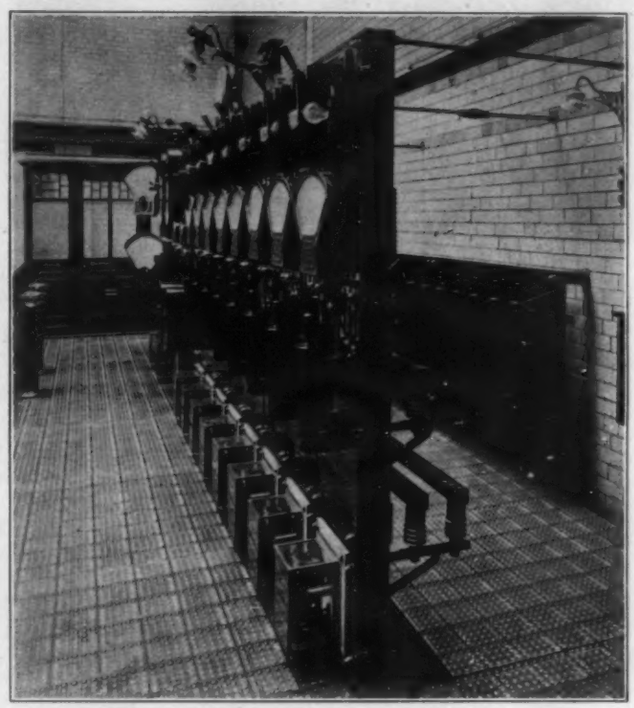
The Preston corporation tramways are supplied with current from a municipal power station, having a supplementary boiler house for reserve in addition to receiving steam from the refuse destructor plant adjoining. This boiler house and pump room is about eighty feet square with space for four boilers, although two Lancashire boilers were installed thirty feet long and eight feet in diameter. The stoking floor is twelve feet wide and runs the whole length of the boiler house. The boilers are designed for working at a pressure of 160 pounds and are each provided with a Bolton superheater placed in the downtake, which is designed to superheat the steam from the boilers to a maximum of 100 degrees above that of the working pressure. An electric motor is utilized for working the scraping gear of a Green economizer, consisting of 256 tubes. There are also two vertical tubular feed water heaters each of 104 square feet effective heating surface.

Electric power is largely used for the auxiliary machinery, a single reduction electric motor with rawhide spur gearing being utilized in the pump room for driving a three-throw, single acting feed pump, having an output of 1000 gallons per hour at a speed of 100 revolutions per minute. There is also a direct acting steam feed pump capable of delivering 750 gallons per hour, and a hot well and feed tank beneath the floor of the pump room having a depth of five feet and covered with steel plates.

The electric railway engine and generating room is 37½ feet high, 55 feet wide, and 83 feet long. Provision has been made for two 300-kilowatt units and one 500-kilowatt set, the former being installed on foundations of solid concrete 12 feet deep and 48 feet long by about 26 feet wide.

The two 300-kilowatt compound wound railway generators which have been installed and in successful operation for some time are of the Dick Kerr construction and are driven by horizontal compound engines built by Cole, Marchanz & Morley of Bradford, England. These engines drive the direct current dynamos at a speed of 100 revolutions per minute and have fly-wheels weighing fourteen tons and measuring sixteen feet in diameter. The high-pressure cylinder is seventeen inches in diameter and is fitted with Corliss valves and automatic cut-off motion operated by the engine governor. The stroke is thirty-six inches and the low pressure cylinder which is thirty-four inches in diameter is also fitted with Corliss valve gear, the cut-off of which can be varied by hand while the engine is in motion. The crank shaft is fifteen inches in diameter and is of high-grade steel, and each engine is fitted with permanent indicator motion to each line of cylinders, together with all the necessary apparatus and cocks.

During the official trials of this electric power-house equipment, the combined efficiency of the engine and generator was found to be 85 per cent, the consumption being 12.25 pounds of steam per indicated horsepower and 19.5



SWITCHBOARD OF PRESTON ELECTRIC RAILWAY POWER PLANT

pounds of steam per kilowatt hour measured at the terminals of the generator.

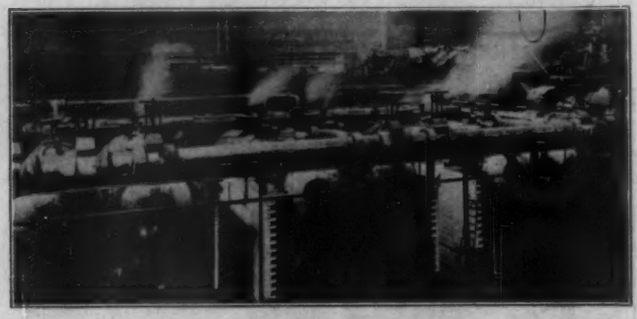
A cooling tower was provided, having an effective cooling area of 70,000 square feet and an internal capacity of 8000 cubic feet, the tower being 43 feet high, 21½ feet long and 11½ feet wide, and two cooling fans installed on steel girders, each 9 feet in diameter. A 10-horsepower electric motor is used for driving each of these fans at a speed of 110 revolutions per minute, the capacity of each being 62,000 cubic feet of air per minute. For cooling water the town's supply is used, and a 55-horsepower electric motor is employed for driving the complete condensing set, the circulating pump being of the centrifugal type capable of delivering 50,000 gallons of cooling water per hour to a vertical height of 46 feet to the cooling tower.

At one end of the engine room the switchboard and accessories are mounted on a platform, the board of the Ferranti design consisting of eleven black enameled slate panels two inches thick. There are eight feeder panels, a Board of Trade panel and two generator panels equipped with the usual

ammeter, voltmeter and recording ampermeters, also automatic circuit breakers, double throw switches, wattmeters and lightning arresters and choke coils.

Below the switchboard gallery there is a booster set provided, consisting of one 20-horsepower shunt wound motor directly coupled to one 8-kilowatt and two 2-kilowatt series wound negative boosters constructed at Bradford, England, by the Phoenix Dynamo Manufacturing Co., Ltd.

A complete workshop is provided equipped with electrically operated machine tools, and a car shed having a steel roof. It contains six tracks with accommodations for thirty double-deck cars. These cars seat forty-eight passengers, twenty-two inside on longitudinal seats and twenty-six on the top deck on garden seats. There are twenty-six cars



HARFELD'S DESTRUCTOR CELLS AT FULHAM PLANT

twenty-eight feet long and four larger cars thirty-four feet in length, the latter being equipped with two 35-horsepower motors and the former with two 25-horsepower traction motors.

The permanent way has a gauge of 4 feet 8½ inches, with 6.3 miles of double track and 3.7 miles of single track. The sharpest curve has a radius of 42 feet and the steepest grade is 1.16. The rails weigh 95 pounds per yard on straight track and 101 pounds on curved. The rails are laid on a bed of concrete eight inches thick, two inches of concrete being above the sole of the rails and forming a continuous anchorage. At each joint two solid Chicago "Crown" bonds are used, 0000 B and S gauge, each 38 inches long, with cross bonds 60 inches long every 40 yards on single tracks and inter cross bonds at every 80 yards on double track. The bridging bonds are 00 B and S gauge, while all points and crossings are bonded with 0000 bonds at each end and 00 bridging bonds across.

There are seven positive and six negative feeders, varying from one-fourth square inch to one-half square inch in sectional areas. These feeder cables are of the non-metallic sheathed class, insulated with the dialite dielectric, double taped, and braided with heavy jute. These cables are drawn into stoneware conduits laid in tiers of two to twenty-two ducts throughout the various routes and laid in a solid bed of concrete. A three-core pilot cable has been laid along all of the routes for tests and telephone circuits and connected throughout the system to every feeder pillar.

The trolley wire is of hard-drawn copper 000 gauge with a resistance of .235 ohms per 1000 yards and a breaking strain of 5000 pounds, mounted on about 1000 steel poles, weighing from 840 pounds to 1240 pounds. These steel poles constructed at Glasgow by Stuart & Lloyd are made in three sections. The trolley wire is in sections varying from one-third to one-half mile in length and supported by span and pull wires of galvanized steel seven-twelfths gauge.

In the city of Preston the cars are operated on the ten-minute service with an accelerated schedule during the rush hour, and the stopping places are fixed at approximately 160-yard intervals on all routes. The average speed over the system is eight miles per hour, and it is stated that the maximum speed has been fixed by the Board of Trade at twelve miles per hour.

Former Mayor William Margerison, and now alderman of the city of Preston, maintains that the refuse destructor plant of that English city has been operating most successfully and works to great advantage and with great saving to the taxpayer in connection with the Municipal Electric Railway.

PROJECTED ELECTRIC LINE FROM MILAN TO GENOA.

United States Consul J. E. Dunning reports that an electric railroad 85 miles in length and to cost $47,000,000 is to be built between Genoa and Milan, Italy.

The electrical current will be generated by water power by three engines of 24,000 horsepower. To complete the line 19 tunnels will have to be built, the most important being 12 miles long, which will require six years in its construction. The cost of the road will be about $500,000 per mile, according to the estimate. The line will have a double track, the trains being hauled by electric locomotives. The latter will be combined with baggage cars, with two sets of trucks, having four motor axles, each axle of 300 horsepower, and will weigh 45 tons. With this force of 1200 horsepower per locomotive they will be able to operate at a speed of about 54 miles an hour for parts of the line having a grade of eight feet per thousand and at a speed of 80 miles an hour on the level. The trains will be run in three cars, each car carrying 50 persons—the whole train weighing 160 tons. These figures are for the express and local trains. The plan is to have them running from 4 o'clock in the morning till midnight. The express trains will run every two hours. The locals will run much oftener, and will collect passengers from the smaller towns and take them to the express station farther along the line, where passengers can transfer. All locals will, after leaving Milan, take all passengers collected from the smaller stations to the station of Tortona—the only express station—as well as those locals starting from Genoa. The express trains will take passengers from Milan to Genoa, or vice versa, in one and one-half hours, while the locals will require two and one-half hours. In this way there will be 20 trains per day, carrying an average of 6000 persons.

The 70 to 100 freight trains to run each 24 hours will have combination locomotive and baggage cars of the same size and power as those of the passenger trains, and will pull 30 freight cars, each car weighing 22 tons, which includes 12 tons of goods on each car, so that the train will pull in all 700 tons. These trains will run at the speed of 20 miles an hour on the inclines, and about 35 miles an hour on the level.

To prevent accidents, there will be no grade crossings along the line, and 372 bridges must be built. The principal tunnel will be perforated from both ends at once, and at the same time in eight places along the lines, boring holes from above. In all, this tunnel will be constructed from ten borings at the same time. By the time this tunnel is ready the whole line will be finished.

SOURCE OF POWER.

By John Harisberger.*

Realization of profitable commercial and industrial conditions depend very largely on the possibility of obtaining cheap motive power, and the cheapest known power is that derived from natural waterfalls, which is energy coming nearest to being perpetual motion, having any practical value, to be found on this globe.

In the transformation and transmission of this power into such shape that it can be applied to do useful work in localities where work to be done is desired, loss of power occurs. To keep this loss to a minimum is necessary for satisfactory commercial results. This is a problem for the engineer.

Taking for granted that a location has been found where water power can be developed and data as to preliminary work, regarding approximate fall and amount of water available, has been secured, the next step will be to check this data of preliminary work by taking accurate measurements of the flow of water in the stream for several months, desirably during the low-water season. If the elevation of the power site is 2000 feet or over, the supply of water for streams will be derived mostly from glaciers and melting snow, and the low-water season will be in the winter months; while a power site nearer sea-level, the stream being fed by rain, springs, and melting snow in the foothills, the low-water season will be during the summer months. This is especially the case in the Northwest.

While gauging the stream as much information as possible should be obtained from old settlers in the neighborhood regarding flow of the stream in past years, and if the government has been maintaining gauging stations on the stream, records of the United States Geological Surveys will be of considerable value as they are fairly accurate.

The watershed of the stream should be explored to ascertain the nature of the country drained, especially as to forests, and find out if the forests are private property or in the government reserve. Heavy forests on the watershed are of material value from a water-power standpoint, as they tend to regulate the rate of discharge of the stream. Their sponge-like property has the effect of retarding the flow of water to stream, and snow falling during the winter is protected from the sun by the trees, which is the cause of the gradual discharge of the stream instead of a spasmodic flow, as will be the case if the watershed be barren of trees. From this it is evident that it is desirable that forests in basins, at elevation below 3000 feet, drained by streams utilized for power purposes, be in the government reserve, for if they are private property it will only be a question of a short time when the trees will be cut down, thus destroying one of the best and cheapest power storages we have.

By comparing the measurements taken of the stream with information obtained regarding its flow in past years, and making a profile of flow, which would look something like Figure 1, of a stream flowing into Puget Sound, where most of the watershed is below 3000 feet elevation. From this the average flow can easily be determined by the aid of a planimeter. In the past, in fact it is the practice at the present time, to build the power house of no greater capacity than the power of the stream at low-water flow, in which case at least seventy-five per cent of the power available goes to waste by the water flowing to lower level without doing any useful work. Ideal conditions are seldom found as to watershed in its natural state, so that the flow of the stream is uniform the year around, so artificial means must be employed for the storage of the water that the entire flow off of the stream the year around can be utilized. If this can be done, a power house of at least the capacity of average power of stream should be built.

In making an artificial storage basin several things will have to be considered. The most important one is, will it pay? Dams will likely have to be built, land be purchased which will be flooded by the water in basin, and possibly course of stream be changed, which will necessitate securing more water rights. If, by figuring up everything, you find that the cost of storage basin is not more than $20 per horsepower for each horsepower obtainable above power of stream at low-water flow, it is a good commercial proposition.

Surveys must be made to find out exact location of stream where power is to be obtained, so that you will know what land it will be necessary to buy, in order to secure absolute right to use water without the possibility of outside interference.

In securing water rights conditions differ, depending in what localities power is to be developed. The law in this part of the country is that you must not change the natural course of a stream unless it be on your property, and, if diverted, must be brought back to its natural course before it leaves your property. In localities where irrigation laws are in effect, the appropriation doctrine is generally in force, the condition being that if you wish to use water of a stream, you must post a notice on the bank of the stream in the neighborhood where power is to be developed, appropriating the number of cubic second feet, or miner's inches, of water wanted, and file copy of notice with auditor of county where power is to be developed and begin active development work within sixty days. These are the conditions in general. New laws are added and old ones changed as the country is settled.

Having secured absolute water rights, active development work should begin. As stated before, in the transformation and transmission of power, loss of energy occurs. This should be considered at the very beginning of the development work, so as to keep this loss down to a minimum with the least expenditure of money. Having ascertained the amount of average flow of stream, the next step will be to run levels and make surveys to establish a location for power house, where greatest fall can be obtained. This having been done, a location for intake will be decided on, and the lay of the land be examined to ascertain what will be necessary to conduct water to power house under pressure, according to head. If the nature of country is such that the constructing of water conductor from intake to location of power house where greatest head is obtainable will be very expensive, it may be more profitable to decide on a location for power house where cost of water conductor can be kept down very much, but at a loss of a few feet in head. This is a matter of calculation depending upon the amount of revenue that could be obtained from the power available by the few extra feet of fall. If the revenue obtained from the extra feet of head is sufficient to pay interest and depreciation charges on the difference of the cost of the two water conductors and some profit besides, the more expensive one will be decided on. This is one of the many problems that confront the engineer in the development of water power, and if the development is for profit instead of pleasure, the solution in general will be in each case as outlined above.

Location of power house having been established, levels will be taken to determine the exact difference of elevation of head water and location for discharge of tail water. This difference of elevation determines the hydrostatic head and is occasionlly given to water-wheel builders, as the head under which wheels are to operate, and wheels designed accordingly, but when put in operation fail to give efficient results. I will explain the cause in detail in my next lecture on Prime Movers.

Having obtained measurements giving hydrostatic head and flow of water, and knowing what the practical possibilities are for storage of water, the capacity of power house that should be built can easily be determined by the following formula: Horsepower equals .1134 times cubic second

*Lecture to the class in Power Transmission, University of Washington.

feet times head times 71 per cent.

This gives the power at switchboard, allowing for losses in pressure pipe, water wheels and generators, or about seventy-one per cent of the power, which is about as good as can be obtained with apparatus available and average power sites. Many conditions must be considered when establishing location for intake and power house. The possibility of back water interfering with the operation of the water wheels, which may be caused by floods occurring only about once in ten years should not be overlooked.

The shortest possible length of pressure pipe between intake and water wheels for a given head is desirable for good speed regulation with economical use of water, and not have excessive cost of pressure pipe, on account of its large diameter, to keep down velocity of water, satisfactory regulation is impossible when a long pipe line is used for a low head plant, and it is attempted to vary the velocity of the water in the pipe for speed regulation.

In high head plants, where the velocity of the water is kept constant in the pipe, governing being done by diverting part of the water from the runner of the water-wheel, the question of length of pipe line will only be a matter of cost, and convenient locations for intake and power house. The intake for pressure pipes should, if possible, be a storage basin of comparatively large area, so velocity of water will be very low, thus allowing any grit or sand to settle to the bottom. This basin should have a sluice gate, so sediment can be sluiced out occasionally without going down pressure pipes and through water wheels. Sand and grit are very detrimental to the life of water wheel runners, as well as the water wheel housing and pipe line, and every means should be employed to eliminate any sand from the water that is to come in contact with the water wheels. The higher the head the more important this is.

There are several methods of eliminating some of the sand from the water. Having intake for pressure pipes, a storage basin as just described is generally the most practical. If a flume is used, sand traps at intervals in the flume help considerably. If an open ditch is used, settling basins at intervals, of generous size, if possible, so velocity of water will be quite low, give good results, if basins can be drained occasionally to sluice out sediment. Open wooden flumes, especially if built on trestle work, should be avoided, as they are generally more cause of trouble than any other part of the plant. If, for any reason, the flume springs a leak, or becomes choked that water overflows, foundation of trestle will be washed out, if it is not on solid rock. A closed stave flow pipe is more desirable, if it is not necessary to empty pipe often, and leave it empty long enough so it will become very leaky, on account of the wood shrinking. It is a question whether in the long run an iron flow pipe would not be the most profitable. The pressure being very low, it can be made of very light material, and, when properly constructed, is not liable to give trouble, unless a landslide breaks it, when repairs will be more difficult than with a wooden structure. Slush ice is not likely to form in a closed pipe in cold weather as in an open flume, but if flume is of such dimension that velocity is low enough that water will freeze over, trouble with slush ice forming in flume is not likely to occur, in which case a deep and narrow flume is desirable to keep down friction losses. This condition will be the same with earthen ditches. An open ditch is another method of conducting water from stream to intake. If nature of country is suitable, and velocity of water can be kept down low, this is the cheapest and best method. Velocity of water in flumes, seven to eight feet per second, depending on design and construction of flume. Velocity in iron flow pipe about the same. In earthen ditches velocity should not be over three feet per second, preferably less.

In developing water power there is rarely ever a case where it is not necessary to build a dam, generally several. If the velocity of stream is high at the location where dam is to be built it is most likely the river bed and banks are of rock formation, in which case a concrete dam would be the proper construction, as a very substantial structure could be built on account of being able to get good anchorage, which would not be the case if the river bed and banks are soft earth and a long distance to bedrock, when a dam of rock-filled crib work construction would be better. Earthern fill dams are sometimes used.

CONCRETE TELEGRAPH POLES.

The Pittsburg, Fort Wayne and Chicago Division of the Pennsylvania Railroad is experimenting with concrete poles for their telegraph service. In the Fall of 1906 they erected a mile of these poles on their right of way near Maples, Indiana, in order to test them out in actual service

They were built by Mr. Herman Tapp, contractor of Fort Wayne, at Maples, Indiana, and were hauled out on cars to the point of erection. The profile of the ground being somewhat uneven, the lengths of the poles were varied from twenty-five to thirty-four feet, in order to keep the tops of the poles as nearly as possible on a continuous grade. The poles were 8 inches square at the bottom, and were tapered to a 6-inch square at the top, the corners being chamfered two inches, making the pole appear octagonal above the ground.

Holes were left for the brace and cross-arm bolts and also for the steps. The reinforcement consisted of twenty-four ¼-inch wires running the full length of the pole. The conditions under which the poles were erected were not of the best, as the work was rushed in order to have the pole line complete for the date of a certain inspection trip. Because of this fact some of the poles were moved from the point of building and were erected within five days after they had been made. Nothwithstanding this hurried method of construction and the severity of the windstorms of the past winter, the poles show up at present in almost perfect condition. The alignment is of the best, and the condition of the individual poles is very good, as no check marks or other signs of failure have appeared. The poles were set four feet under the ground and were bedded in stone screenings giving a solid foundation. Although the time these poles have been in use is not sufficient to warrant any sweeping statements as to their value, yet it is a fact that the first eight months of service have certainly showed exceptional results in favor of the use of concrete for this purpose. These can probably be put in at a cost of $8.00 per pole.

INDUCED DRAFT IN THE BOILER HOUSE.

In a paper by an English author on "Notes on the Application of Induced Draft," reference was made to one case in particular of five boilers fitted with steam jets, which resulted in a coal consumption of 27.3 pounds of coal per square foot of grate, the evaporation from and at 212 degrees being 9.8 pounds of water per pound of coal, with a temperature of the economizer water of 166 degrees. With induced draft the results obtained were as follows: Coal consumption per square foot of grate, 25.4 pounds, evaporation of water, 10.2 pounds per pound of coal; and temperature of economizer water, 259 degrees. Taking measurements of the electrical output of the plant, it was found that, using the steam jets, for each unit of electricity 3.6 pounds of coal and 30 pounds of water were consumed. With induced draft the results were 3.1 pounds of coal and 28 pounds of water per unit of current. In this case 1800 gallons of water were simply evaporated for use by the steam jets. The net saving in this case worked out at 14½ per cent.

THE ELECTRICAL DRIVING OF WOODWORKING MACHINES.

By E. L. Nichols.

It is certain that no one not actively engaged in the building of electrical machinery appreciates the extent to which the motor drive is being employed in all lines of mechanical and engineering work. The modern electric motor with its superior economy, reliability, and flexibility of application fits into almost every conceivable situation, so that the rapidly increasing proportion of manufacturers of special machinery have acceded to the popular demand and are now either supplying their appliances with motors attached, or so constructed that motor drive can be readily applied.

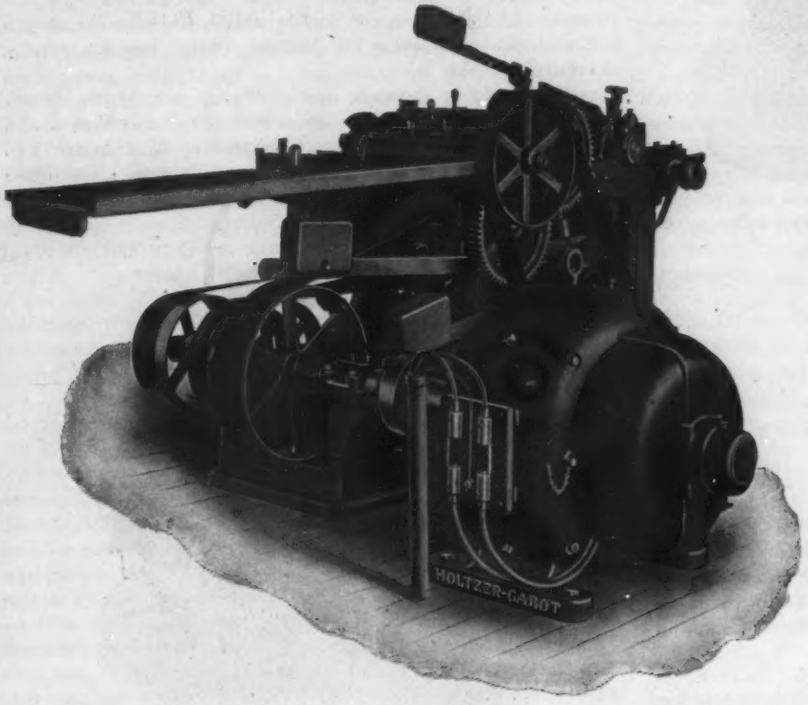


FIG. 1. OUTSIDE MOULDER DIRECT CONNECTED TO ELECTRIC OTOR

Each day produces new evidence that the electric motor is growing in popularity as a means of driving wood working machines. Some of the best plants built this year are provided with individual motor drive, and a number of others now in contemplation will make use of electric power. It is getting to be quite a common thing to read, in connection with the equipping of a new wood working plant, that electric motors are to be used for driving the machines. Of course some new plants put in engines, and use shafting and pulleys just as has been done for generations, but a sufficient number of the new ones are putting in electric drives to make the matter highly interesting. Their experience will be watched by a growing number of other mill and factory owners who would like very much to adopt the electric drive but have the same feeling about it that people usually have toward a new method which displaces one that is time honored and well understood.

A great deal might be stated in favor of electrical driven equipments and especially where the individual drive is adopted, but some of the most important advantages together with illustrations of a few typical installations will suffice for this article.

The item of wear and general depreciation of overhead shafting and pulleys is one which cannot be lost sight of and is one which tends to increase rather than decrease from year to year. A large nvmber of accidents, some of which are fatal, result annually from long lines of shafting and pulleys. With the individual electric drive there is no shafting nor belting to speak of, for the motor is direct connected by coupling or short belt (for speed reduction) to the machine in question. The only wear, then, is on the motor and the machine, both of which are so constructed as to last a goodly number of years without undue repairs.

Another point in favor of the electric motor is the alacrity with which it responds to any given piece of work. The switch is thrown and it starts immediately upon the first notch of the controller. There is no fear of overloading the shop by running all the machines at once for each is separately driven and the motors are built to withstand a large per cent of overload without undue heating or sparking.

Then a point which has already been touched upon, is the cost of operating an entire plant for the use of one or two machines. It frequently happens that "Rush" orders necessitate a part of the plant working nights or holidays, in which case all the shafting is run to operate two or three machines which are liable to be located in a remote portion of the shop furthest from the engine room or water wheel. This is no small matter and many times overtime is dispensed with on account of the excessive operating expense, even to the result of losing some business. The individual electric drive makes it possible to operate each machine as cheaply at night and on holidays as during regular running hours, for only as many motors are consuming current as there are machines running, and as a rule power costs no more at night than in the day time. A large saving in operating expense is brought about in this way as may be readily seen.

Furthermore with the electric drive, there are no operating expenses except for such time as the machines are actually in operation. There is no necessity to "fire up" before dawn and start the engine several minutes before opening time, for electric power is always ready, and it is shut off with equal ease

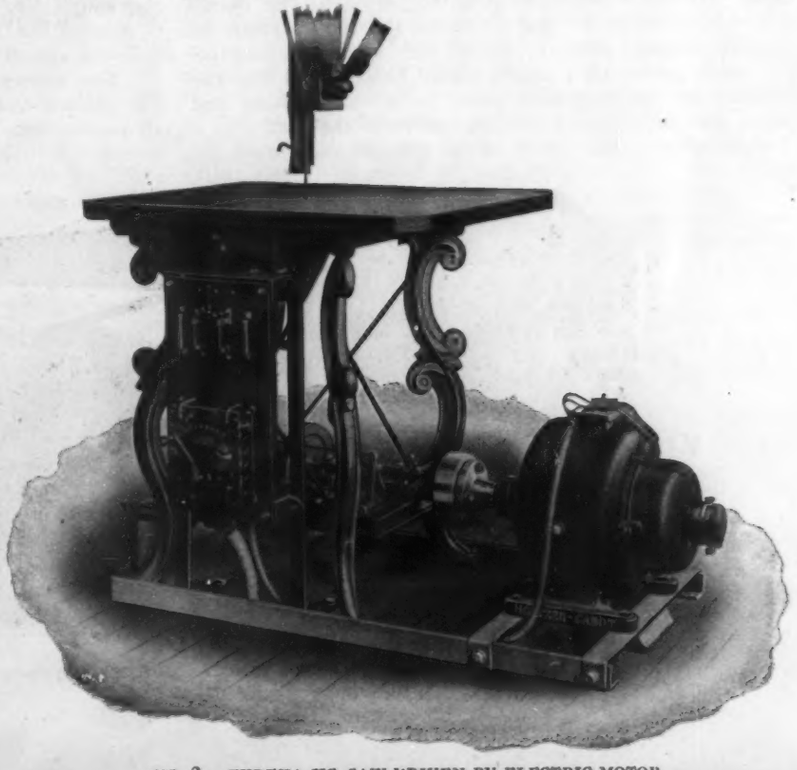


FIG. 2. EUREKA JIG SAW DRIVEN BY ELECTRIC MOTOR

and dispatch at closing time. This saving will be instantly appreciated.

Not only are cumbersome shaftings and belting a menace

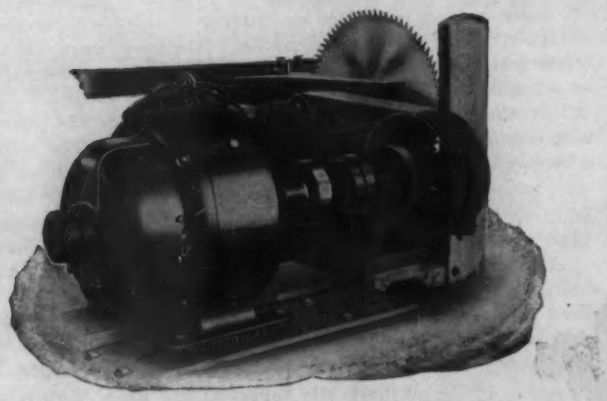


FIG. 3. RAILWAY CUT-OFF SAW DIRECT CONNECTED BY COUPLING TO ELECTRIC MOTOR

to life and limb in a wood-working establishment, but from an aesthetic point of view are equally as bad. They make the rooms darker and tend to keep the dust in motion, instead of allowing it to settle, thus making the atmosphere far from healthy for the employees. The enclosed type of motor does not stir up the air, and is practically dust and moisture proof, which increases its efficiency, and is conducive to cleanliness and good health.

Throughout a plant of large size the loss of power due to shafting friction and belt slipping, is greater than is generally imagined, and when this is entirely eliminated by installing the individual electric drive, the saving will be sufficient to pay for a large part of the expense of making the change.

It is admitted that the first cost of electric motors, especially one for each machine, means quite a little delay, but when taken into consideration with the saving which will result annually as long as the plant is in operation, the balance is in favor of the operators of the establishment.

It may be also stated here that it is possible to make the change to electric power without interfering to any extent with the operation of the plant, as the motors may be installed during working hours and the final connections made quickly after closing time. Thus, one by one, the machines are changed over until finally the shafting and belting may be relegated to the archives of the past.

Electricity is the power of the present and future for some time to come, and stands a peer for economy, cleanliness, flexibility and efficiency.

The accompanying five illustrations show dust-proof motors manufactured by The Holtzer-Cabot Electric Company, Brookline, Mass., direct-connected to a variety of wood-working machines. These outfits are installed at several navy yards, and demonstrate the latest engineering practice in this sort of work.

Figure No. 1 shows the above type of motor direct-connected by couplings to a Woods Machine Company's No. 129 Outside Moulder. Figure No. 2 shows a similar type of motor direct-connected to a Eureka Jig Saw. The entire absence of belts in this cut will be noted, and also the switch and controlling rheostat are located where they are readily accessible to the workman.

Figure No. 3 shows a motor of this description direct-connected by coupling to a 40-inch railway cut-off saw, and Figure No. 4 shows the direct-connection of a motor and Atlantic Works' No. 4-B, 44-inch band re-saw. The illustration in Figure No. 5 shows a dust-proof type of motor direct-connected to counter shaft of S. A. Woods Machine Company's No. 173 Double Circular Saw. The belts shown in some of the illustrations form a part of the machine giving different speeds to different parts of the machine.

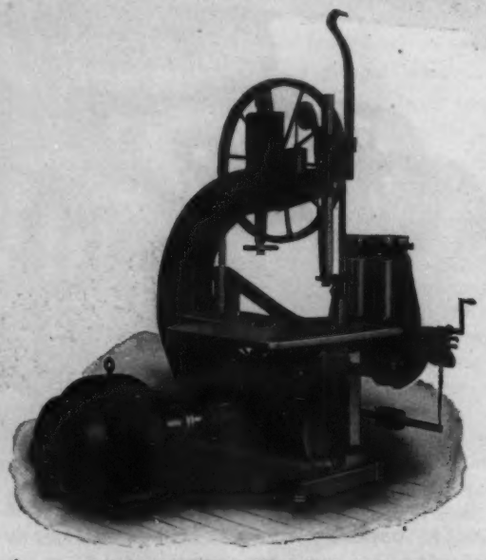


FIG. 4. DIRECT CONNECTION OF MOTOR AND BAND RE-SAW

The services of the motor engineering department of The Holtzer-Cabot Electric Company are at the disposal of all parties who may be interested, and information in this direction will be gladly given upon request.

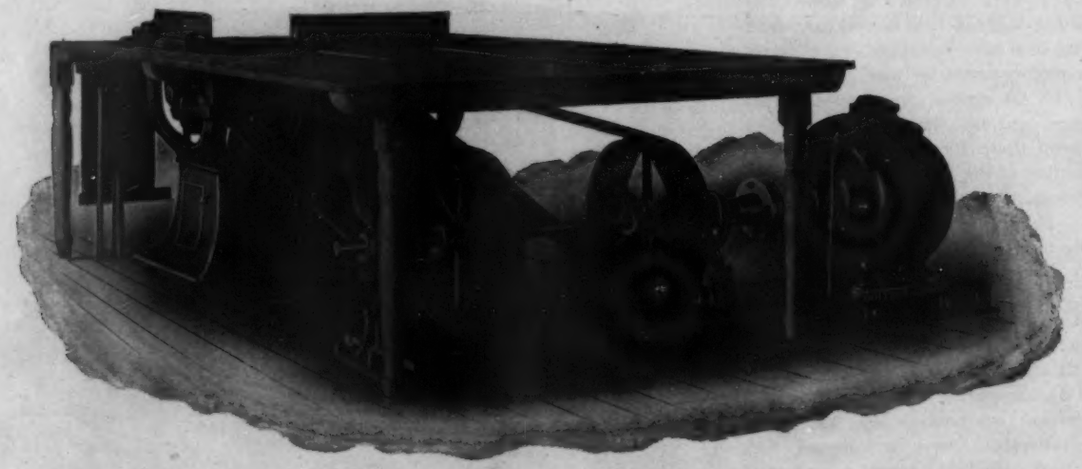


FIG. 5. DUST PROOF MOTOR DIRECT CONNECTED TO DOUBLE CIRCULAR SAW

PROTECTION FROM FIRE.

Fire has always been the worst enemy of the forest. In many cases the risk of fire is so great after lumbering that landowners have not tried any system of conservative logging, but have instead cut the forest clean in the belief that young timber would be burned, if left, before it could attain sufficient growth for a second crop. This is almost the rule in the heavy forests of the Pacific Coast, where fires have been so prevalent that they have come to be regarded as a necessary evil. A single fire among young trees may not always kill them, but it will check their growth and weaken them so that they will be very susceptible to insect attacks and fungous diseases. Recurring fires, however, at last destroy the whole forest stand, and then chaparral takes possession. On cut-over lands there is usually a great accumulation of debris, and this encourages fire, so that one of the first steps in fire protection is some provision for the removal of debris.

In 1904 the Forest Service in co-operation with the State of California made a thorough study of forest conditions and their relation to fire on the tract of the McCloud River Lumber Company, in Siskiyou County, Cal. The chief object of this study was to devise some practical system of forest protection. The results, which are now published in Circular 79 of the Forest Service, show (1) that by proper care and the execution of certain measures it is possible to decrease, or even to eliminate, the danger from forest fires; (2) that such protective measures may be carried out at a reasonable cost; and (3) that the results in most cases will fully justify the necessary expenditures.

The plan adopted, which aims to prevent fires from starting by means of patrol along carefully laid-out routes, was executed so successfully that it has since been extended to all the holdings of the company. Telephone and tool stations have been established, and broad fire lines on which the slash was burned have been run through the cut-over land. The cost of all this was about 2 cents per acre per annum.

The details of this plan, accompanied by a description of the tract and the forest types, and an estimate of the future yield and value of cut-over lands protected from fire, are given in the circular, which is entitled "The Control of Forest Fires at McCloud, California." This publication will be sent free upon application to the Forester, United States Department of Agriculture, Washington, D. C.

LARGEST GASOLINE PASSENGER LAUNCH IN THE WORLD.

(Staff Correspondence.)

One of the most interesting achievements in the maritime world is the erection and completion on this Coast of the largest gasoline passenger launch in the world. The boat has been in steady service since the first of January between San Pedro Harbor and San Diego, making two round trips a week with two additional trips to Avalon and Coronado Islands, giving perfect satisfaction. The engines have never stopped for repairs or adjustment since the first alignment. The craft is 140 feet long, 22 feet beam, with a draft of 10 feet. It is allowed 256 gross tons and will carry 260 passengers comfortably, with an average speed of about fourteen knots. There are two 6-cylinder engines, each of 300 horsepower, making a total of 600 horsepower. The boat is driven by a twin screw. It also carries a 16-horsepower, 4-cylinder, direct connected lighting engine, which supplies light and heat to the craft, and also a 12-horsepower fire pump engine.

The engines were designed and built by Mr. G. F. Stephenson of 1263 Bellevue Avenue, Los Angeles, Cal., now with the S. J. Smith Machinery Company of that city.

THE WATER POWERS OF PERU.*

The present developments of the southern Peruvian water power, reports Mr. Guarini, professor of physical and electrical science at the "Escuela de Artes y Oficios" of Lima, Peru, are insignificant, being limited to a 1000-horsepower installation furnishing light and power to Arequipa, and a very modest private lighting plant in the Tambo Valley.

At Mollendo there is today no power plant of any description. The Peruvian Corporation is about to install a steam plant to furnish power for industrial purposes and harbor work during the day, and for public lighting at night. The high cost of fuel and the uninterrupted demand for power during the twenty-four hours, however, make the advantages of a water-power installation apparent.

In the immediate vicinity of Mollendo, in the Tambo Valley, there are a number of small streams capable of developing several hundred horsepower, which can be easily utilized and transmitted electrically. The supply of power available from this source is so much greater than any demand in sight for it at Mollendo, that a primitive wooden water-wheel of local manufacture, in connection with a dynamo and a few kilometers of copper wire, would amply suffice for present requirements and would represent a great saving in first cost and in operating expense over the proposed steam plant. The utilization of the city's water supply to operate a wheel before entering the distributing mains suggests an alternative source of power.

Mollendo gets its water from the mountains at an elevation of 2300 meters above sea-level, whence it is conveyed a distance of 140 kilometers through pipes, 20 centimeters in diameter at a velocity of 20 litres per second, according to Chief Engineer Bustamante y Raneda, in his recent report and project for increasing the water supply of Mollendo. Friction losses would average five millimeters per meter of pipe, or 700 meters for the entire distance, not including loss of head from short turns, bend and angles.

On the basis of 1 horsepower equals 175 kilogramme meters, net available, and allowing 75 per cent as the efficiency of the wheel, the theoretical available power would be 320 horse.

In practice, however, writes Professor Guarini, this result could not be obtained for two reasons: First, because the present pipe line could not resist the attendant pressure of 219 atmospheres, and, second, because the entire theoretical head is not available, owing to the fact that the line is sectioned off in several separate reservoirs at different levels, serving to supply intermediate towns and villages, and also to relieve the pressure on the line.

The power problem would consequently have to be solved by either of the following methods:

1st. By installing a water-wheel and alternating generator set at the mouth of each reservoir, feeding a single cable carrying the current to Mollendo and furnishing power to different localities on the way. Under existing conditions, at least 250 horsepower could be delivered in this manner at Mollendo during 24 hours, supplying 3000 standard 16-candle-power lamps, equaling 48,000 candle power, or 3000 special filament 32-candle-power lamps, equaling 96,000 candle power.

This output could be further increased, adds Mr. Guarini, by installing a storage battery at Mollendo, which could be charged during the daytime.

2d. By building two reservoirs at Mollendo at different levels, the lower one to be used as the supply reservoir proper for distribution, and the other as a water-power storage basin, which would empty into the lower reservoir during lighting hours.

Under present conditions, each reservoir would have a capacity of 900 cubic meters (that being the capacity of the existing basin) and a difference of mean level of 220 meters

*Abstract from the "Engineering Magazine."

(that being the actual difference between the Mollendo reservoir and the last section basin). This would give a flow of 10 litres per second for 24 hours, or 40 litres per second for 6 hours, or an equivalent of 88 actual horsepower, sufficient to supply 1000 special 32-candle-power incandescent lamps for 6 hours, which would be fully adequate for the immediate needs of the little town of Mollendo.

According to Mr. Guarini, the Tambo Valley abounds in small water-powers, which could be easily developed to supply power to run the machinery in the sugar mills that dot the valley, during the day, and to light the many estates and farms at night.

Today the only application of these natural forces is to be found on Mr. Lira's plantation, where a miniature electric-lighting plant is run by a very primitive and inadequate water-wheel of native design.

At Arequipa the "Sociedad Electrica de Arequipa" owns and operates a hydro-electrical central station at a place called Charcani, about eleven kilometers from the town, the motive power for which is supplied by the Chile River, with a maximum capacity of 1000 horsepower. Current will be delivered at Arequipa over a three-phase line of 5400 volts, for power and lighting purposes, as soon as the installation is completed.

The intake flume, about 1300 meters long, has a capacity of 4 cubic meters per second. With an available head of 26.5 meters it is possible to develop a theoretical force of 1413.33 horsepower and an actual output at the water-wheel shaft of about 1060 horsepower. The original equipment consists of two turbines consuming 865 litres of water per second, and developing 248 horsepower each, or a total of 496 horsepower. Each wheel operates a single-phase, alternating-current, 50-cycle, 5400-volt generator.

The high-tension current is carried over an eight-wire line into Arequipa, a distance of 12,500 meters, where it is converted to 110 volts at a sub-station, through sixteen static transformers of capacities varying between 2 and 20 kilowatts.

Mr. Guarini says that Arequipa today uses ten 1000-candle-power arc lamps and 4391 incandescent lamps of different ratings, aggregating 77,972 candle-power. The lighting service is, however, most unsatisfactory, owing to the insufficiency of the present equipment to meet requirements. As a result, the streets are half the time in the dark, and complaints from private subscribers are constant—the company being unable to supply the current contracted for and give satisfactory service, on the one hand, and the consumer trying to get even with the company, on the other, by using lamps on their circuits of double the rating that they are entitled to, in an effort to get a modicum of brilliancy.

The Sociedad Electrica de Arequipa, it must be admitted, is now installing an additional 500-horsepower equipment, which should suffice for present requirements, although, as a matter of fact, an entirely new hydro-electric plant would be advisable in order to bring the light and power service up to the standard expected in a first-class city of the importance of Arequipa.

Another source of supply, Professor Guarini writes, should be the Chile River, which is amply capable of furnishing all the motive power necessary for the purpose, representing, as it does, a colossal hydraulic force hitherto overlooked.

Mr. Habich, director of the Technical School of Lima, in an article published in the Bulletin of the Mines of Peru, in its issue of July 31, 1901, pointed out that Peru, with its rivers descending from elevations of 3000, 4000 and 5000 meters, possessed incalculable sources of power and showed that the Rimac River alone was capable of developing at least 100,000 horsepower.

Returning to the River Chile itself and basing calculations from a point a little above the location of the present station at Charcani, about 3000 meters above sea-level, Mr. Guarini estimates that this stream carries a volume of water of six cubic meters per second, equal to a theoretical force of 240,000 horsepower. By properly damming the Chile between Charcani and sea-level it would be easy to develop a minimum effective power of 100,000 to 120,000 horsepower.

The objection to such a scheme would be the fact that the water thus taken from the stream could only be used for irrigation after passing through the water-wheels, which, if installed at sea-level, would render such utilization impossible, whereas the Peruvian government is unequivocally opposed to the granting of any water rights whatever that would interfere with its plans for increased irrigation facilities. In the eastern part of Peru there is such an abundance of water that this restriction does not obtain, but on the seaboard it is necessary either to utilize the higher levels of the streams (up in the mountains), or to have recourse to partial and successive developments so as not to interfere with irrigation. For the specific case of Arequipa the latter plan is the most practical.

Professor Guarini proposes the following solution: By lowering the location of the present plant about 400 meters, it would be a simple matter to increase the head from the 26 meters now available to at least 100 meters. This would in no wise prejudice irrigation, as there are no lands whatever under cultivation between the present and the proposed locations of the plant.

By lengthening the present flume or ditch, a force of 4000 horsepower could be developed, while by building a new flume of sufficient capacity to carry the six cubic meters of which the Chile River disposes, a force of 6000 horsepower could be obtained.

With such a supply of electrical energy available the electrification of the railroads of Southern Peru would follow in due course, either totally or partially, creating a large market for power.

The Peruvian Southern Railroad operates 359 kilometers of road over an average grade of 1.3 per cent, between Mollendo, which is at sea-level, and Crucero Alto, the highest point on the line, at an altitude of 4.840 meters.

The next and by far the most important source of water-power supply of Peru, points out the hardy pioneer, is Lake Titicaca, lying 3800 meters above the level of the sea, with a surface area of 6600 square kilometers and an average depth of 20 meters.

Lake Titicaca is an isolated basin into which a great number of rivers empty. The outlet of this basin is the River Desaguadero, which discharges its waters into Pampa Aullagas, where they are lost through evaporation and filtration. There is a popular belief that a subterranean stream continues and discharges into the sea, but scientific investigations have failed to substantiate the theory and it appears certain that this water is absorbed only by evaporation and filtration. The fact remains, however, that the Desaguadero River before entering the Pampa Aullagas carries a volume of 100 cubic meters of water per second, whereas the stream that serves as outlet to this lake has a volume of only one cubic meter per second.

For various reasons, and especially for the purpose of utilizing this water for irrigation after leaving the turbines, it is desirable to have this water fall over the Pacific Slope. Lake Titicaca lies in a hollow, surrounded on all sides by an unbroken ridge of mountains, ranging from 250 to 800 meters in height, presenting a formidable engineering problem which can be overcome by only two solutions: either tunnelling through the mountain, or pumping the water up and over the lowest practicable eminence.

The distance from Lake Titicaca to the Pacific Ocean, as the crow flies, is 250 kilometers.

According to surveys, the shortest practicable tunnel that could be bored through this natural barrier to the nearest valley would be between thirty-five and forty miles long. This, while entailing an enormous cost, would greatly shorten the transmission line.

As regards the alternative plan of pumping the water

over the side of the mountains, it should be called to mind that the highest point on the ridge immediately encircling the lake is Crucero Alto, at an elevation of 4600 meters, or about 800 meters above the level of the lake. In the event of an actual undertaking of such an enterprise, a much lower point would, of course, be determined upon after proper surveys; but for the purpose of demonstrating its feasibility, Crucero Alto will be selected, indicates Professor Guarini, as the peak to which the water must be raised, and, furthermore, the pipe line will be assumed to follow the tracks of the Peruvian Southern Railroad (a very much longer and more circuitous route than would be taken in practice), a total distance of 524 kilometers.

To raise 100 cubic meters of water one meter in one second requires 1900 horsepower with good pumps. The difference in levels between the surface of the lake and Crucero Alto being 800 meters, a force of 1900 times 800, equals 1,520,000 horsepower would be necessary.

At first sight this figure appears appalling, but it will be shown hereafter that the available supply of power for the pumping station would be far in excess of this amount.

One hundred cubic meters of water under a head of 4600 meters represent a theoretical force of 6,133,333 horsepower, which, after deducting 1,520,000 horsepower consumed at the pumping station, would still leave a theoretical supply of 4,613,333 horsepower to dispose of.

Assuming the penstock to be built of a number of pipes, each one meter in diameter and carrying a volume of 628.3 litres of water at a velocity of 0.8 meters per second, loss of head may be estimated at one meter per kilometer, or 524 meters for the entire line, equal to 698,666 horsepower to be deducted.

Further, allowing 1,914,667 horsepower for losses from all sources, in the turbines, generators, etc. (which is extremely liberal), a net surplus of 2,000,000 horsepower of electrical energy would be left available for sale.

The plan above which has been, as aforesaid, suggested by Mr. Guarini, provides for the driving of the pumps by the electrical energy generated by their own initial action, but it must, of course, be understood that steam is contemplated as the original motive power at the pumping station. For example, a pumping station would first have to be installed on the edge of Lake Titicaca, at a suitable point such as Puno, driven by steam, with a capacity sufficient to force one cubic meter per second to a height of 800 meters. Such a pump would consume 1520 horsepower to perform the work.

This water would be pumped into a reservoir at Crucero Alto, from which it would fall by gravity to sea-level, where it would develop, as above shown, an actual net force of 35,000 horsepower of electrical energy, or more than double the power required to drive the pump at Titicaca. After supplying this power to the first pump, there would be a reserve force of 20,000 horsepower left, which could be used to drive a second pump, and so on successively until, with adequate capacity in the Crucero-Alto reservoir, one hundred pumps could be kept in automatic operation, delivering a net total of 35,000 minus 15,000 times 100, equaling 2,000,000 horsepower, as above demonstrated.

The market for this supply of power would be in its application to the electrification of present steam roads and the operation of new electric properties, mining and agricultural industries, public and private lighting, the manufacture of carbide of calcium at the coal mines, the operation of overhead conveying cables, which are in general use in Peru, and for heating, household and general power purposes.

A petition is now before Congress urging the appointment of a special commission to make surveys and reports on the feasibility of such a development and to prepare estimates on the probable cost of construction, with a view of drawing up a bill of conditions governing a concession under which foreign capital will be invited to undertake the project.

NITRATES FROM THE AIR.

The world's supply of natural nitrate comes from Chile and is being so rapidly exhausted that thirty years' time will likely see the end of it. Nitrogen constitutes the most important of the three fundamental elements of plant food, the other two being potassium and the phosphates, so that without nitrogen for plant food vegetation would starve when the supply becomes exhausted, and the failure of vegetation would mean starvation throughout the animal kingdom.

Recognizing this situation to which the world was drawing near, Professor Frank and Doctor Caro, scientists of Germany, set about to find a method of deriving nitrogen artificially from the air itself, as the atmosphere is an inexhaustible reservoir of that element, and binding it in a compound to serve as a vehicle by which it could be handled practically and of such a nature as well as would be slowly soluble and capable of assimilation by plant life after being placed in the soil. This same Professor Frank was also the inventor and founder of the present industry for making potassium fertilizers which has done so much for agriculture. For sixteen years they have given their best labor and abilities to this most important problem and have during the last six months perfected it as a commercial process, and patents protecting its use and manufacture have been secured from all the civilized nations, the rights to which patents have been parcelled out to different interests in the several nations.

The rights for America have been taken over by two American engineers, Mr. Frank S. Washburn and Mr. Charles H. Baker, of 100 Broadway, New York.

The final product which the process obtains is composed of limestone, coal and nitrogen, and is popularly called "lime nitrogen," twenty per cent of the weight of which is nitrogen. The chemical name of the compound is calcium cyanamid. This compound not only has its direct use as an agricultural fertilizer, but it will be most extensively used in the chemical arts for the production of ammonia, nitric acid, and other useful things. As a measure of the magnitude of the consumption of Chilian nitrate it might be mentioned that the United States alone imported last year 375,000 tons of it, having a value of $20,000,000. A column of the atmosphere resting on any two acres of the earth's surface contains the same amount of nitrogen as did last year's importation from Chile.

The new fertilizer—lime nitrogen—costs less to make than Chilian nitrate is sold for, so that the worn-out farms of any poor farmer will be within reach of its restorative and fertilizing properties. Two crops in Europe have already proved its great value where the nitrogenous elements have been lacking, and it is thus known that such crops as wheat, tobacco, cotton, sugar cane, and truck gardening are greatly increased by its use. The original lime nitrogen factory in Italy, which runs night and day, is already so much overtaxed that its capacity is now being more than doubled.

The Agricultural Department at Washington is taking a great interest in the new fertilizer and is having it investigated by the department experts. Great factories for its manufacture are now in process of construction in several of the nations in Europe and one of them which is under way in Germany will involve the construction of a 75,000 horsepower water-power plant. The parent company is the Societa Generale per la Cienamide of Rome, Italy, which is controlled by the Deutsche Bank of Berlin, Germany, and the Siemens & Halske Company, also of Berlin, the largest electric manufacturing company in Europe, which companies financed the very costly experiments and researches conducted by Messrs. Frank and Caro during the long period of experimentation leading up to their great invention. The same German int rests will have a considerable financial interest in the American company.

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EDITORIAL.

THE PRINCIPLE OF THE "OPEN SHOP."

San Francisco has been Union-ridden so long that the opinion is strongly prevalent that her doors are closed to the principle and practice of the "Open Shop." When the logical and natural argument in favor of industrial freedom, exemplified in the text of the "Open Shop," is advanced the average San Franciscan, employer or employee, shakes his head, as much as to say that this city is forever committed to the industrial, if not political, domination of Trade Unionism. Is this diffidence well founded?

Certainly, if we must measure the temper of this community by the fearsome attitude of many of our merchants and other employers, it would seem that this fundamental principle of American institutions, guaranteed by the law and the constitutions of both State and Federal Government, has lain so long dormant that its disuse is mistaken for its destruction. On all sides we hear men, both employers and employed, protesting against the despotism of Union leaders, their irritating regulations, their apparent determination to have even more to say about the conduct of any business or any industry than those responsible for their foundation and financing. But the protest is generally rather the lamentation of those who like "any old fish can swim down stream." Something more than protest is needed for a live fish to swim up stream.

It is the painful experience of those who for years, believing in the basic principles of Labor Unionism, have preferred to deal with an organized body than with individuals in their employ, that the walking delegates and agitators remain satisfied no longer than Irish politicians. You give them an inch; they want an ell. Their conditions are frequently as intolerably restrictive upon the employed as upon the employer.

The basic principles of Labor Unionism have come, here as elsewhere, to stay. The man who thinks that Labor Unionism can be "downed" and Labor Unions dissolved, and proceeds along such a course, might as well ram his head against a brick wall. As "The Journal" pointed out last week, the evolution of Trade Unionism has generated abuses, as well as uses. It is these abuses that sometimes make employers "fighting mad." But the employer who talks of "fighting Labor Unions to a finish," and imagines that it is to the permanent, vital interest of capitalists to array themselves against Labor Unions, is a false and foolish prophet. Such tactics are absolutely futile, and are calculated to aggravate the social disorders and the quarrels between the employed and the employers, rather than to diminish or eliminate them. The axiom that Labor and Capital are inter-dependent forces apparently needs constant inculcation. They are natural allies, and the man who makes them artificial enemies is pulling down, instead of building up.

Whatever strength Trade Unionism may obtain in any community, even though the majority of a community are either members of Unions or sympathize with them; however powerful their organization may be, not only industrially but politically, nevertheless, the sacred right of the individual, employer or employed, to buy or sell labor as seems best to the individual must be acknowledged. For such individual liberty is a fundamental principle of the Constitution of the Republic of the United States. Both State and Federal Constitutions ordain the principle of industrial freedom; the law and its officers are supposed to protect, and, if need be, to enforce that principle.

When one comes to contemplate calmly the tremendous opposition and antipathy to the very idea of the "Open Shop," the fair-minded man is amazed. For instance, we read in a daily newspaper, especially the mouth-piece of local Unions, that "the 'Open Shop' in San Francisco is an **impossibility,**" and that, "Surely Mr. Calhoun does not wish to be the instrument by which San Francisco is to be offered as a vicarious sacrifice on the altar of the 'Open Shop.'"

"It would not be pleasant for Mr. Calhoun," con-

tinues this organ, "to be responsible for the commercial ruin of this city. * * * It surely cannot be for the benefit of Union Labor men that San Francisco should be selected as the battle-ground on which the bitter battle of the 'Open Shop' is to be fought."

Mr. Calhoun is a builder, not a destroyer. His company is responsible for the greatest single investment in San Francisco. His company is the heaviest taxpayer in San Francisco. Last year alone the United Railroads spent six million dollars in the improvement of its system. In fighting for the principle of the "Open Shop" Mr. Calhoun sees no "commercial ruin" in sight; on the contrary, he foresees that the peace and prosperity of San Francisco depend on the establishment of the principle of the "Open Shop." In his address before the Conciliation Committee of the Civic League the president of the United Railroads convinced his auditors of the undenied and inviolable justice and fairness of the principle of the "Open Shop." Mr. Calhoun said: "It is of the utmost importance to the present and future prosperity of this community that the whole country shall be made to understand that men will be permitted to work in lawful occupations in this city, free from the dictation or the interference of any organized body of men. This right is fundamental. * * * Without its full protection there can be no individual liberty, either of employer or employee."

Again Mr. Calhoun plainly laid down the issues which to-day must be faced: "Shall men be permitted to work without threats of coercion and without bodily harm?" In conclusion he hoped "that the Union Labor of this city will aid the United Railroads in demonstrating to the country that life and liberty will be secure in San Francisco, and that men will be permitted to work, whether they belong to a Union or not."

In a recent issue, "The Argonaut" said: "Whether or not we are to have in San Francisco a return to American standards in industry—to the 'Open Shop'—is as yet undetermined. The reason is that both in industry and business we have so large a jelly-fish element that concert of action is slow to be attained. * * * The 'Open-Shop' principle is the one enforcement that would save San Francisco and immediately restore her prosperity. * * * Not until we can hang out the sign of the 'Open Shop' can we hope for such restoration of self-respect and of outside respect as our need calls for."

There are thousands of strong men, and true, in this community. There are thousands who will fight to the last ditch, not against the principles of Labor Unionism, but against the damnable heresy that would lower American standards and undermine the sacred principle of individaul liberty for which our fathers fought. It is quite possible for labor unionists and non-unionists to live, work and thrive in the same community. The rules of the Unions prevent them from working side by side, and there is some logic in such prohibition on the part of the unionists. But the tactics of intimidation and assault which have been all too prevalent in San Francisco during the last few years must forever be fought and frustrated if this city is to regain its own prestige, to restore general confidence, and to realize its splendid destiny.

It is a blasphemy to say that any California city cannot maintain American principles. It is as criminal as it is foolish to cry that the "Open Shop" in San Francisco is an impossibility. The men who are determined to establish industrial freedom in San Francisco need neither pity nor warning. They have counted the cost and are prepared to meet it. None but a traitor can pretend that American principles will not eventually triumph in a noble, libery-loving American city.

TRADE CATALOGUES.

Bulletin No. 30 from the Warren Electric Mfg. Co., Sandusky, Ohio, illustrates and describes the revolving field Warren alternators.

The Rockwell Engineering Company, 26 Cortlandt Street, New York, send two bulletins illustrating the use of oil or fuel gas furnaces for rod and bolt heating.

Bulletin No. 76 from the Wagner Electric Mfg. Co., of St. Louis, gains some interesting information on single-phase variable-speed, ventilating fans as manufactured by this company.

The Westinghouse Companies' publishing department send a handsome brochure of Westinghouse views, including a few views of Washington. This was prepared for the thirtieth annual convention of the National Electric Light Association and is an unusually fine example of half-tone work.

PERSONAL

H. C. Thaxter, manager of the Standard Electrical Works, is in Seattle.

C. R. Weymouth, engineer for Chas. C. Moore Company, has returned to San Francisco from New York.

Roger Chickering, manager of the Wonder Light & Power Company, Wonder, Nevada, is in San Francisco.

Mr. A. A. Peters, southwestern manager of the National Meter Company, with offices in Los Angeles, is in San Francisco.

LOCAL STOCKS AND BONDS

Furnished by Courtesy San Francisco Stock and Bond Exchange.

Outstanding	INTEREST	MISCELLANEOUS BONDS.	JUNE 7		JUNE 8		JUNE 10		JUNE 11		JUNE 12		JUNE 13	
			Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked
1,532,000	F & A	Associated Oil Co. 5%	80	82	80	82	80	.....	80	.....	80	.....	.....	.....
2,250,000	M & S	Bay Counties Power Co. 5%	.....	100	.....	100	.....	100	.....	100	.....	100	.....	100
1,000,000	F & A	Cal. Central Gas & El. 5%	.....	103	.....	103	.....	104	.....	104	.....	104	.....	103
9,600,000	M & S	Cal. Gas & El. Gen. M. & C. T. 5%	.....	79	76	79	.....	79	.....	80	.....	79	.....	79
900,000	J & J	California St. Cable Co. 5%	100	.....	100	.....	100	.....	100	.....	100	.....	100	.....
2,000,000	J & J	Contra Costa Water Co. 5%	100	102	101 ½	.....	101 ½	.....	101 ½	.....	101 ¾	.....	100	102 ½
1,000,000	J & J	do do Gen. Mtg. 5%	.....	97	.....	97	96 ½	98	96 ½	98	.....	97 ½	.....	97 ½
623,000	F M A N	Edison Light & Power 6%	111	119	111	119	111	119	111	119	111	119	.....	116
650,000	M & S	Ferries & Cliff Ho. Ry. 6%	103 ¾	.....	103 ¾	.....	103 ½	.....	103 ½	.....	103 ½	.....	103 ½	.....
671,000	A & O	Geary St. Ry. 5%	52	.....	52	.....	52	.....	52	.....	52	.....	52	.....
610,000	M & N	Honolulu R. T. & L. Co. 6%	105 ¼	.....	105 ¼	.....	105 ¼	.....	105 ¼	.....	105 ¼	.....	105 ¼	.....
300,000	A & O	Lake Tahoe Ry. & T. Co. 5%	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
500,000	J & J	Los Angeles Elec. Co. 5%	100	.....	100	.....	100	.....	100	.....	100	.....	100	.....
1,300,000	J & J	Los Angeles Gas & Elec. Co. 5%	99 ½	.....	99 ½	.....	99 ½	.....	.....	101 ½	.....	101 ½	.....	101 ½
5,000,000	A & O	Los Angeles Ry. 5%	106	.....	106	.....	106 ¼	.....	106 ¼	108	106 ¾	.....	107	.....
1,000,000	A & O	Los Angeles Lighting Gd. 5%	.....	105	.....	105	.....	105	.....	105	.....	105	.....	105
1,500,000	A & O	Los Angeles Pac. R. R., 1st Con. Mtg. 5%	.....	103 ½	.....	103 ½	.....	103 ½	.....	103 ½	.....	103 ½	103	103 ¾
3,030,000	M & S	L. A. Pac. R. R. of Cal. 5%	.....	101 ½	.....	101 ½	.....	101 ½	.....	101	.....	.....	.....	.....
3,000,000	J & J	Market Street Cable 6%	.....	106	105	.....	107	.....	107	.....	107	.....	107	.....
5,141,000	M & S	do Ry. 1st Cons. Mtg. 5%	.....	107 ½	.....	.....	.....	105	.....	105	.....	105	.....	105
100,000	A & O	Mill Valley & Mt. Tamalpais S.Ry. 5%	103	.....	103	.....	103	.....	103	.....	103	.....	103	.....
4,751,000	A & O	Northern Ry. Co. of (Cal.) 5%	109 ½	.....	109 ½	110 ½	110	.....	110 ¼	.....	110 ½	.....	111	112
1,498,000	J & J	North Pacific Coast R. R. 5%	100	.....	100	.....	100	.....	100	.....	100	.....	100	.....
1,074,000	J & D	Northern Cal. Railway 5%	.....	.....	100	108	.....	106	.....	106	.....	106	.....	107 ½
980,000	J & D	Northern Cal. Power Co. 5%	.....	100	.....	100	.....	100	.....	100	.....	100	.....	100
6,000,000	A & O	Northern Electric Co. 5%	.....	97 ½	.....	97 ½	.....	97 ½	.....	97 ½	.....	97 ½	.....	97 ½
1,000,000	M & S	Oakland Gas Light and H. 5%	100	106	100	106	101 ½	.....	100	.....	104	.....	103	106
1,374,000	J & J	Oakland Transit Co. 6%	109 ½	.....	110	112	110	.....	110	112	110	.....	110 ½	.....
1,600,000	J & J	Oakland Transit 5%	101 ½	.....	101 ½	.....	101 ½	.....	101 ½	.....	102 ½	.....	102 ½	.....
1,326,000	J & J	Oakland Transit Con. 5%	100	.....	100	.....	100	.....	100	.....	100	.....	101	.....
7,000,000	J & J	Oakland Traction Con. 5%	.....	100	.....	100	.....	100	.....	100	100	.....	100	.....
1,500,000	J & J	Oakland Water Co. gtd. 5%	.....	99	.....	99	.....	99	.....	99	.....	99	.....	99
2,000,000	A & O	Omnibus Cable Ry. 6%	112	118	112	118	112	118	112	118	112	118	112	118
1,149,000	S D M J	Pacific Gas Imp. 4%	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	95
8,494,000	J & J	Pacific Electric Ry. Co. 5%	102	103	102	103	102	102 ½	102	102 ¼	102	102 ½	102	.....
4,491,000	J & J	Pacific Light & Power Co. 5%	.....	100 ½	.....	100 ½	.....	100 ½	.....	100 ½	.....	100 ½	.....	100
3,000,000	J & J	Pacific Tel. & Tel. Co. 5%	.....	102 ½	.....	102 ½	.....	102 ½	.....	102 ½	.....	102 ½	.....	104
350,000	J & J	Park & Cliff House Ry. 6%	100	.....	100	.....	.....	104	.....	104	.....	104	.....	.....
250,000	J & J	Park & Ocean R. R. 6%	.....	112 ½	.....	112 ½	.....	112 ½	.....	112 ½	.....	112 ½	.....	112 ½
700,000	M & S	Powell Street Railway 6%	.....	107 ½	.....	107 ½	.....	107 ½	.....	107 ½	.....	107 ½	.....	107 ½
2,500,000	M & N	Sacramento Elec. Gas & Ry. 5%	.....	99 ½	97 ½	.....	98	100	98	.....	98 ¾	100	98	100
6,000,000	A & O	S. F. & S. J. Valley Ry. 5%	110	.....	111	115	110	.....	110	.....	111	.....	111	.....
3,000,000	J & J	S. F., Oak. & San Jose Ry. 5%	103	105	.....	105	.....	105	102 ½	105	102	104 ½	.....	105
1,500,000	J & J	do do 2d Mtg. 5%	.....	101	.....	101	.....	101	.....	101	.....	101	.....	101
1,500,000	A & O	S. J. & S. Clara Co. R. R. 4 ½%	.....	91	.....	91	.....	91	.....	91	.....	91	.....	91
642,000	A & O	Sierra Ry. of Cal. 6%	107	.....	107	.....	108 ½	.....	108 ½	.....	108 ½	.....	108 ½	.....
6,000,000	J & J	S. P. R. R. of Arizona 6% (1909)	103 ½	.....	103 ½	.....	103 ¾	.....	103 ¾	.....	103 ¾	.....	103 ¾	.....
4,000,000	J & J	do do do (1910)	104	.....	104	104 ¼	104	.....	104	.....	104	.....	104	.....
5,116,000	A & O	S. P. R. R. of Cal. 6% (1912)	105	.....	105	.....	105	.....	105	.....	105	.....	.....	110
4,127,500	M & N	S. P. R. R. of Cal., 1st c. gtd. 5%	114	.....	114	.....	114	.....	114	.....	114	116 ½	113 ⅜	116 ⅞
3,533,000	A & O	S. P. Branch Ry. of Cal., 6%	122 ½	.....	122 ½	127 ½	123	.....	123 ½	.....	124	.....	123 ½	.....
81,178,000	J & J	S. P. R. R. Co., 1st Ref'd'g. 4%	90	.....	90	.....	91 ½	90 ½	.....	85 ½	90	.....	90 ¾	.....
17,500,000	J & D	Spring Valley Water Co. Gen. Mtg. 4%	.....	85 ¼	84	85 ¼	.....	85 ½	.....	.....	.....	86	.....	86
300,000	M & S	Stockton Gas & Elec. Co. 6%	100	.....	100	.....	100	.....	100	.....	100	.....	100	.....
2,000,000	J & J	United Gas & Elec. Co. 5%	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20,000,000	A & O	United R. R. of S. F. 4%	69 ¾	.....	70	70	.....	70 ⅜	.....	70 ⅜	.....	70	70 ¾	
2,500,000	M & N	Valleys Counties Power Co. 5%	.....	100 ¼	.....	100 ¼	.....	100	.....	100	.....	100	.....	100
		Water Stocks.												
.....	.....	Contra Costa	59	.....	59	.....	59	.....	59	.....	.....	62	.....	62
6,000	Quarterly	Marin County	.....	62	.....	62	.....	62	.....	62	.....	62	.....	62
280,000	.....	Spring Valley Water Co.	19	19 ¼	19 ¼	19 ½	19 ½	19 ¾	20	20 ¼	20	20 ¼	19 ¾	20
		Gas and Electric Stocks.												
37,500	.....	Martel Power Co.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
9,340	.....	Mutual Electric Light Co. (Ctfs.)	4 ½	.....	4 ½	.....	4 ½	.....	4 ½	.....	4 ½	.....	4 ½	.....
37,336	.....	do (Extended Ctfs.)	12	13	12	13	12	13	12	13	12	13	12	13
40,000	Monthly	Pacific Lighting Co.	55	.....	55	.....	55	.....	55	.....	55	.....	55	.....
12,000	.....	Stockton Gas & Elec. Co.	52	.....	52	.....	52	.....	52	.....	52	.....	52	.....
		Street Railroad Stocks.												
10,000	.....	California	.....	142 ½	.....	142 ½	.....	142 ½	.....	142 ½	.....	142 ½	.....	142 ½
10,000	.....	Geary	.....	41	.....	41	.....	41	.....	41	.....	41	.....	41
10,000	.....	Presidio	.....	25	.....	25	.....	25	.....	25	.....	25	.....	25
	Semi-an.	Associated Oil Co.	33 ¼	33 ½	33 ¼	33 ⅝	33	34	33 ½	.....	34 ½	.....	34 ½	34 ¾
1,625	Quarterly	Mill Valley & Mt. Tamalpais S. Ry.	.....	110	.....	110	.....	110	.....	110	.....	110	.....	110
180,000	Quarterly	Pac. Tel. & Tel. Co. (Pfd.)	75	95	75	95	.....	97 ½	.....	97 ½	.....	97 ½	.....	97 ½
180,000	.....	Pac. Tel. & Tel. Co. (Common)	7 ½	.....	7 ½	.....	7 ½	.....	7 ½	.....	7 ½	.....	7 ½	.....

Unlisted Securities

750,000	A & O	Bay Counties Power Co. 6%	.....	103	.....	103	.....	103	.....	103	.....	103	.....	103
745,000	M & S	Blue Lakes Water Co. 6%	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2,000,000	A & O	California Northwestern Ry. 5%	.....	108	.....	108	.....	108	.....	108	.....	108	.....	108
160,000	J A J O	Marin County Water 5%	.....	100	.....	100	.....	100	.....	100	.....	100	.....	100
600,000	J & J	Risdon Iron Works 5%	.....	100	.....	100	.....	100	.....	100	.....	100	.....	100
500,000	M & S	S. F. Dry Dock 5%	.....	109	.....	109	.....	109	.....	109	.....	109	.....	109
8,000,000	M & N	S. F. Gas & Electric 4 ½%	.....	95	.....	95	.....	95	.....	95	.....	95	.....	93
3,926,000	J & J	S. F. & North Pacific Ry. 5%	102 ½	.....	102 ½	.....	102 ½	.....	102 ¾	.....	102 ¾	.....	103	103 ¼
5,500,000	J & J	South Pacific Coast Ry. 4%	.....	95	.....	95	.....	95	.....	95	.....	95	.....	95
.....	.....	Standard Electric Co. 5%	.....	92 ½	.....	92 ½	.....	92 ½	.....	92 ½	.....	92 ½	.....	92 ½
.....	.....	do do Gtd. 5%	.....	95	.....	95	.....	95	.....	95	.....	95	.....	95
750,000	J & J	Sunset Tel. & Tel. Co. 6%	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2,250,000	A & O	Sunset Tel. & Tel. Co. 5%	.....	105 ¼	.....	105 ¼	.....	105 ¼	.....	105 ¼	.....	105 ¼	.....	105 ¼
1,000,000	M & N	Sutter Street Railway 5%	.....	105	.....	105	.....	105	.....	105	.....	105	.....	105
		Stocks.												
50,000	Monthly	Gas Consumers' Association	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
100,000	Monthly	Northern Cal. Power Co.	20	.....	20 ½	.....	20	.....	20	.....	20	21 ½	20	21 ½
.....	.....	Pac. Gas & Elec. (Pfd.)	.....	50	.....	50	.....	50	.....	50	.....	50	.....	50
.....	.....	Santa Cruz Port. Cement	55	60	55	60	.....	60	.....	60	.....	60	.....	60
.....	.....	Standard Port. Cement (New)	.....	65	.....	65	.....	65	.....	65	.....	65	.....	65
50,000	Monthly	Truckee Electric Co.	15	16 ½	.....	16	.....	16	15	16	15	16	.....	16

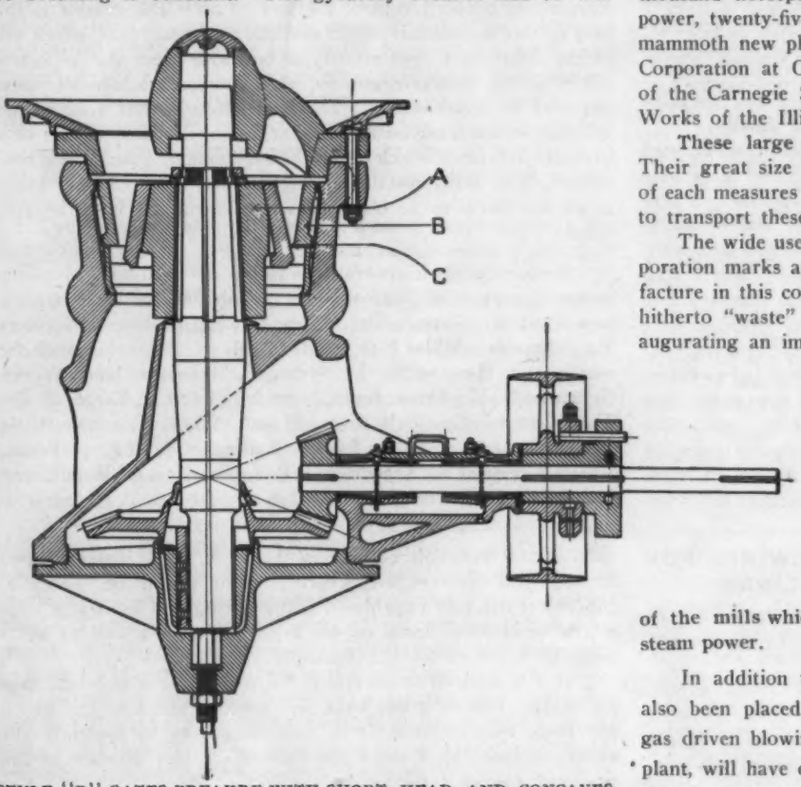
INDUSTRIAL

"GATES" BREAKERS.

Not least among the industrial features to be shown in connection with the Jamestown Exposition will be an exhibit made by Allis-Chalmers Company, of the "Gates" Breakers for crushing ore, rock and other materials which require for their reduction a powerful machine.

This breaker, which is of the so-called "Gyratory" type, was invented some years ago, to overcome the numerous objections to the jaw crusher, the only machine then known that could be depended upon to perform the service required.

The jaw crusher was of limited capacity, its product was not uniform and the machine itself was subject to frequent breakages, due to the severe shocks it had to sustain. These shocks are intermittent, and such a machine must have strength far in excess of what is required when the crushing or breaking is constant. The gyratory breaker had to win



STYLE "D" GATES BREAKRE WITH SHORT HEAD AND CONCAVES

its way to favor against the prejudices of those who, from long using, had become accustomed to former types of machines, but to-day it has gained full recognition. Its introduction has given employment to vast numbers of men in stone quarries and mines, and has reduced the cost of breaking stone to a minimum. This has led to a more extended use of crushed stone for railroad ballast, for concrete work and for road-making material. The cost of producing the metals has also been greatly lowered by the installation of this machine to break up ore and flux.

From the time of the first application of the gyratory principle to rock breaking, Gates gyratory rock breakers have been built by Allis-Chalmers Company, and the development of the machines to meet growing needs has never lagged. More than 6,000 Gates crushers are in use, distributed in all parts of the world.

The phenomenal use of concrete construction during the past two or three years has carried with it such a large demand for finely-crushed stone that, taken in connection with the large quantity of broken rock needed in road construction, ballasting and ordinary building operations, the crushing industry has now become one of very great magnitude. It is, therefore, anticipated by the Exposition authorities that among the visitors to the great Fair, many will be attracted to the Allis-Chalmers Company's breaker exhibit, which may be found in Section 8 of the Machinery and Transportation Building.

LARGEST INDIVIDUAL ORDER FOR GAS ENGINES.

The largest single order for gas engines ever placed in this country, and for the largest engine of this type ever built, has recently been awarded by the United States Steel Corporation to Allis-Chalmers Company, Milwaukee, Wis. Within the past year this company has taken orders for thirty-six gas engines of four thousand horsepower each, or an aggregate of 144,000 horsepower, twenty-five of which are to be installed as a part of the mammoth new plant now in course of construction by the Steel Corporation at Gary, Indiana; seven for the Homestead plant of the Carnegie Steel Company, and four in the South Chicago Works of the Illinois Steel Company.

These large gas engines weigh 1,500,000 pounds apiece Their great size is also demonstrated by the fact that the shaft of each measures three feet in diameter. It will require 2300 cars to transport these machines.

The wide use of gas engines by the United States Steel Corporation marks an important step in the progress of steel manufacture in this country, as they are designed to operate upon the hitherto "waste" gas developed by the blast furnaces; thus inaugurating an important economy in steel production.

The majority of the Allis-Chalmers gas engines on order will drive electric generators of Standard Allis-Chalmers type, twenty-five cycle, three phase. These machines are to be used for generating the necessary power to operate the heavy induction motor driven rolls, the tilting and feed tables for the various passes, the hot saws, hot and cold pull-ups, transfer tables, straightening machines, and cold saws, and other auxiliary machinery of the mills which are now ordinarily operated by means of steam power.

In addition to the gas driven electrical units, orders have also been placed with the Allis-Chalmers Company for twelve gas driven blowing engines. The Indiana Steel Company, Gary plant, will have eight blowing engines, and the Homestead plant of the Carnegie Steel Company has ordered the remaining four units. Each blowing engine has a capaicty of 3500 horsepower, and will deliver 30,000 cubic feet of free air per minute against a pressure of eighteen pounds per square inch which is ordinarily the maximum. Eleven of the gas driven blowing engines purchased by the Steel Company's plants will be equipped with "slick" type blowing tubs, the Amercian patent rights covering which are owned by Allis-Chalmers Company.

In steel plants where steam driven blowing engines have heretofore been using steam furnished by boilers utilizing waste gases from blast furnaces, it is ordinarily found that the amount of gas is at times not sufficient to supply the required power for this purpose only. But the same gas when used in gas engines not only furnishes sufficient gas for supplying all the air required by the furnaces, but also a considerable quantity over and above the requirements, which is used, as in the present instance, for driving gas engine units furnishing sufficient power for the other uses common to the steel mill.

JAMESTOWN EXHIBIT OF H. W. JOHNS-MANVILLE COMPANY.

The H. W. Johns-Manville Company have a large and interesting exhibit at the Jamestown Exposition. Probably the most notable feature of this exhibition was the "Victor" Combination Meter, a variety of forms of which were shown, including switchboard, portable and automobile types. These instruments, which have been described in our columns before, possess the unique feature of giving a simultaneous reading of volts, amperes, watts, and horsepower, on one dial. The instruments are manufactured at the new instrument works of the company in Brooklyn, N. Y., which is one of the best equipped factories of its kind in the country.

A new "automobile" type of meter was exhibited, which attracted special attention. This instrument is intended for electric automobiles, runabouts, etc. It is mounted on a tripod stand and provided with a ball and socket arrangement, by which the instrument can be turned at any desired angle to suit the convenience of the operator. This arrangement also permits it to be turned sideways, for use when the machine is being charged.

Quite a variety of the regular switchboard and portable meters were also shown, in various styles and finishes.

Among the other devices exhibited should be mentioned "Noark" subway and service boxes, of one, two and three pole construction, and 250, 600 and 2,500 volt capacity. These boxes are absolutely watertight, being designed and tested to withstand a pressure of twenty-five pounds per square inch without leaking, and are therefore suitable for the most severe conditions. Also a complete line of "Noark" national standard fuse blocks and accessories, as well as line material devices, were shown. Another feature worthy of mention is "Transite" asbestos fireproof doors, for high tension transformers and switches. These doors are designed for the protection of apparatus from short circuiting; also to prevent persons coming into contact with the live parts. They are made of "transite" asbestos fireproof lumber, a material which possesses the unique feature of being absolutely fireproof, and, at the same time, an excellent insulator.

VENTILATION OF THE BOSTON SUBWAY.

In the Boston subway the change of air once in ten minutes, which is produced by a number of fans, is sufficient to meet all ordinary conditions. But the corresponding rate of flow which is only one linear foot per second from each station toward each center of discharge is extremely low. Such a low rate of flow (which is a measure of the vacuum produced) would leave any ventilating system practically powerless to overcome the effect of ordinary atmospheric changes. A difference of only .01 inch of water is sufficient to produce a velocity about six times greater than that planned for the subway. The result when large open portals and numerous entrances and exits, to say nothing of moving trains, afford ample opportunity for the creation of pressure differences much greater than .01 inch has been to render the ventilation decidedly erratic.

Under these conditions the fan becomes merely local in its effect. It is practically powerless to control the direction of such currents at such differences as exist in the subway. In a word, so long as the subway connects through large openings with the outer atmosphere it is impossible for fans of the capacity here installed to properly control the flow of air. The trouble in the case of this installation is not with the individual fans, which are of the Sturtevant open cone-type, but with their size as determined by the subway engineers, for a fan can mechanically meet any desired requirements. The problem is one of volume and velocity, which must be sufficient to insure the maintenance of a pressure difference which cannot be overcome by atmospheric conditions. The entire installation suggests the false economy which is all too likely to be observed when ventilation is to be provided.

Mechanical draft apparatus is to be furnished by B. F. Sturtevant Company of Boston, Mass., for boilers in the following power plants: Penna, Fort Wayne Chicago Railway, Allegheny, Pa.; Acushnet Mills, New Bedford, Mass.; State Hospital for the Insane, Howard, R. I.; Syracuse Malleable Iron Works, Syracuse, N. Y.; Union Light, Heat & Power Co., Fargo, N. D.; The Fisheries Co., Fall River, Mass.; Wood Worsted Mills, Lawrence, Mass.; El Paso Electric Railroad Co., El Paso, Texas; Russia Cement Co., Anacortes, Wash.; and Hazard Manufacturing Co., Wilkesbarre, Pa.

APPROXIMATE RULE FOR SIZE OF WIRES FOR THREE-PHASE TRANSMISSION LINES.

The table given below is for use in making rough estimates for the sizes of wires for three-phase transmission service, as in the following example:

Required: The size of wires to deliver 500 kilowatts at 6000 volts, at the end of a three-phase line 12 miles long, allowing an energy loss of 10 per cent and a power factor of 85 per cent. If the example called for the transmission of 100 kilowatts (on which Table A is based), we should look in the 6000-volt column for the nearest figure to the given distance, and take the size wire corresponding. But the example calls for the transmission of five times this amount of power, and the size of the wire varies directly as the distance which in this case is 12 miles. Therefore we look for the product 5x12 =60 in the 6000-volt column of Table A. The nearest value is 60.44 and the size wire corresponding is No. 00, which is, therefore, the size capable of transmitting 100 kilowatts over a line 60.44 miles long, or 500 kilowatts over a line 12 miles long as required by the example.

If it is desired to ascertain the size wires which will give an energy loss of 5 per cent, or one-half the loss for which the table is computed, it is only necessary to multiply the value obtained by 2 since the diameter varies directly as the per cent energy loss.

TABLE A.

Distances to which 100 kilowatts three-phase current can be transmitted over different sizes of wires at different potentials, assuming an energy loss of 10 per cent and a power facor of 85 per cent.—Furnished by The General Eldctric Co.

Number B. & S.	Area in Circular Mils.	Distance of Transmission for Vatious Potentials at Receiving End											
		2,000	3,000	4,000	5,000	6,000	8,000	10,000	12,000	15,000	20,000	25,000	30,000
6	26,250	1.32	2.98	5.28	8.27	11.92	21.12	33.1	47.68	74.50	132.4	206.75	298
5	33,100	1.66	3.75	6.64	10.40	15.00	26.56	41.6	60.00	93.75	166.4	260.00	375
4	41,740	2.10	4.74	8.40	13.15	18.96	33.60	52.6	75.84	118.50	210.4	328.75	474
3	52,630	2.54	5.96	10.16	16.55	23.84	40.64	66.2	95.36	149.00	254.8	413.75	596
2	66,370	3.33	7.51	13.32	20.85	30.04	53.28	83.4	120.16	187.75	333.6	521.25	751
1	83,690	4.21	9.48	16.84	26.32	37.92	67.36	105.3	151.68	212.00	421.2	658.00	948
0	105,500	5.29	11.92	21.16	33.10	47.68	84.64	132.4	191.72	298.00	529.6	827.50	1192
00	133,100	6.71	15.11	26.84	41.97	60.44	107.36	167.9	241.76	377.75	671.6	1049.25	1511
000	167,800	8.45	19.04	33.80	52.85	76.16	135.20	211.4	304.64	476.00	845.6	1321.25	1904
0000	211,600	10.62	23.92	42.48	66.42	95.68	169.92	265.7	382.72	598.00	1062.8	1660.50	2392
	250,000	12.58	28.33	50.32	78.67	113.32	201.28	314.7	453.28	708.25	1258.8	1966.75	2833
	500,000	25.17	56.66	100.68	157.35	226.64	402.72	629.4	906.56	1416.50	2517.6	3933.75	5666

NEWS NOTES

ORGANIZATION FOR OPEN SHOP.

Within the past three weeks local capital and the interests connected with the building industry have been unionizing to meet the abnormal conditions imposed by union labor. The movement began about the time of the action of the Builders' Exchange in appointing a committee to work for a stable rate of wages and unchanged prices for building material for one year's time.

Large estates and other property owners have been laying plans at numerous meetings to continue building construction on the open-shop basis, in case the unions are unable to furnish the necessary amount of labor. Owners representing $8,000,000 of immediate construction work, and including some of the city's largest capitalists, have agreed to shut down work on large buildings on account of the scarcity of workmen needed to rebuild the city, and the fact that the unions will not permit the increase of the body of laborers by allowing non-union men to work without intimidation and violence.

One of the leaders in the movement declares there are but 35,000 available workers, and that reconstruction demands 90,000.

Local building interests have brought about the organization of a syndicate of outside capitalists, who will advance $10,000,000 within the next month, to be used in construction on the open-shop basis only. It is said that a few San Franciscans have subscribed funds to the syndicate.

Another combination in the building line is composed of contractors, large construction companies and material men who favor the open-shop plan and agree to build or furnish material on that principle only.

A representative of one of the interests said: "We have lined up one organization of property owners and large estates, who have agreed to shut down immediate construction work, which would cost $8,000,000, until the normal rate of wages is restored. In the event of the unions refusing to reduce wages, this organization will furnish the necessary amount of labor required while the buildings are being constructed on an open-shop basis. The construction companies and material men have joined in the agreement, and a syndicate, which has just been incorporated outside of this State, will furnish money for open-shop building.

"There is no desire to resort to this defense if the unions will agree to a normal rate of wages and furnish the necessary amount of labor required or allow the employment without interference of non-union men in the event of their being unable to supply the labor."

TRANSMISSION.

Santa Rosa, Cal.—It is being proposed to grant a franchise to Frank M. Burris, to erect and maintain wire lines for transmission of electricity for heat, power and light and other purposes, and telegraph and telephone lines, incidental thereto along highway in Sonoma County. Bids will be received for the franchise up to July 3rd.

St. Helena, Cal.—Sealed bids will be received by the Board of Trustees up to 8 p. m., July 9th, 1907, for the sale of a franchise that has been applied for by Henry Brown to erect and maintain along the streets poles and wires for transmission, electric light, heat and power, in St. Helena.

IRON WORKERS RESUME WORK.

The iron workers' strike is over.

San Francisco Lodge No. 68, Association of Machinists, have ratified the agreement proposed jointly by the Metal Trades Association and by the Iron Trades Council and ratified by the majority of unions affiliated with the Council.

The action of that lodge, taken at a special meeting Wednesday evening, it is understood, will be accepted as final by the other lodges of machinists of this city and vicinity. It terminates the strike in the iron trades and insures industrial peace for at least three years.

Twice within the week has that lodge rejected the same terms, though the Iron Trades Council, of which the lodge is a component part, has ratified the agreement on two occasions, and it was expected that the affiliated unions and lodges, including the machinists, would abide by and confirm the action of the central council. The California Metal Trades Association, accepting the action of the Iron Trades Council as binding upon all its affiliated unions, signed the agreement with the duly authorized representatives of the council and announced that all machine shops, foundries and ship-building plants would reopen on last Monday morning.

Notices were posted in front of the shops to that effect, and the men who had been on strike for weeks hurried to apply for work at their former places.

The machinists held a special meeting Saturday evening, but instead of rescinding their former action and ratifying the agreement, they again rejected it. This act so exasperated the employers that the committee having the matter in charge hurredly called a conference of the Metal Trades Association and decided to keep the shops closed until all the unions in the iron trades should accept the terms.

One lodge of boilermakers and some few other unions affiliated with the Iron Trades Council had also rejected the agreement. On last Monday morning several thousand mechanics and workmen applied at the shops ready to go to work, but were turned away. A few shops, whose owners had not been informed in time, opened their shops and started work, but closed as soon as they learned of the action of the association.

The influential members of the various unions and recognized leaders renewed their efforts with the members of Machinists' Lodge, No. 68, in an effort to have that lodge accept the terms, which they considered the best obtainable at present.

ILLUMINATION.

Yuma, Ariz.—Seth Hartley has returned to Yuma from Colton and will superintend the immediate construction of the local gas plant. It will be in operation by July 15th.

Alameda, Cal.—The Electricity Committee of the City Council reported to that body recently its proposed plans for the operation of the municipal electric light plant. The plan calls for the construction of a new fire proof building, the installation of a new generator unit, a new boiler, and the extending of the power and electric light service. The estimated cost is $58,000. In case the money is allowed, $18,000 will be expended on the new building, $25,000 will go for the new unit, $6,000 for the new boiler, $1,800 for improving the power service, and $1,500 for improving the lighting service.

TELEPHONE AND TELEGRAPH.

Prineville, Ore.—The Pioneer Telephone Company has absorbed several local lines in Burns County.

Tacoma, Wash.—Home Telephone Company expects to begin business, June 25, with 400 business phones.

Albridge, Mont.—The Montana Coal & Coke Company will make improvements and extensions to its plant.

Stevensville, Mont.—Farmers in vicinity of Burnt Fork region are attempting organization of a rural telephone company.

Anacortes, Wash.—The Independent Telephone Company, which had a franchise for a system here, has decided not to build.

Helena, Mont.—H. E. Mott, engineer of construction, is preparing to put Independent Telephone lines underground. This is an automatic system.

Prosser, Wash.—New switchboards are being placed in office of Yakima Valley Telephone Company, and will later be installed at Toppenish, Wapato and Mabton.

Helena, Mont.—The Gould-Lincoln Telephone Company, with capital of $10,000, has been incorporated by H. L. Miller, J. A. Russell, of Chicago, and R. R. Johnson, of Los Angeles, and will build a line 150 miles long in Blackfoot country.

Bremerton, Wash.—Paulsbo Rural Telephone Company has been granted a franchise for the lines in Kitsap County.

Davenport, Wash.—N. T. Caton, city attorney, is opposed to granting telephone franchises to J. J. Nichols and associates.

Boise, Ida.—A new stamp mill is being installed at the Black Pearl Mine, to take the place of the Elspass mills, now in use. The mill will be operated by electric power from the Payette power plant. An auxiliary steam plant will be built to insure constant operation of the mill.

Sonora, Cal.—The Government telephone line from Sonora to the range camp near Smith's Station, ten miles beyond Groveland, has been completed, and Supervisor S. L. N. Ellis, of the Forest Reserve, has been notified that the necessary appropriation has been made to continue the line to the camp at Anderson Valley, on Bull Creek, a distance of twenty-two miles.

Rhyolite, Nev.—Fred M. Hess, principal owner of the Inyo Telephone Company, is preparing to extend the service to this and all the Owens Valley. Henry C. Lee, of Harron, Rickard & McCone, machinery agents, is here from Los Angeles. He will recommend that a branch office be put here for the sale of machinery. A branch will be started at Phoenix, Arizona.

Ely, Nev.—J. R. Marsh, manager of the White Pine Telephone Company, has returned from Salt Lake, where he held a conference with the officials of the Utah Independent Telephone Company, and states that he has made arrangements to connect the White Pine Line with the line leased to the Western Pacific by the Utah Independent Company. Later, he states, the White Pine County Company will connect with a line to be built to Tonopah, and then to Reno.

Coeur d'Alene, Ida.—A quantity of machinery, including a hoist, pump and a sawmill, has been ordered for the Legal Tender Mine on Prospect Gulch, near the Evolution Mine, in the Coeur d'Alenes. The sixteen claims of the group are now being surveyed for patent, after which the 80-foot shaft will be deepened to the 250-foot level. New buildings are to be erected, and the mine will be developed as rapidly as possible. About $15,000 will be spent on the improvements now planned.

WATERWORKS.

Emeryville, Cal.—Emeryville is to have a salt-water plant for street-sprinkling and fire-fighting purposes. The system is to be operated within a year, and will cost $50,000.

Rhyolite, Nev.—The actual work of installing the Ash Meadow Water System has been begun, and upon the completion of this enterprise Southern Nevada will have a water system that is second in magnitude only to the Owens River System, which is being installed by the City of Los Angeles. The new system will open the country for a radius of 100 miles, and will enable mining to be carried on in places now closed for lack of water.

San Francisco, Cal.—The stockholders of the Olympic Salt Water Company, which furnished the supply of ocean water to the Olympic Club and distributed it to other parts of the city prior to the fire, met and re-elected the old Board of Directors of the company, naming John D. Spreckels as president. Plans have already been made for rehabilitating the salt-water plant at once, and one of the first improvements to be made will be the establishment of a tub bath house with 500 baths on Geary Street, between Scott and Devisadero.

San Francisco, Cal.—Messages have been received from James D. Phelan, at Washington, to the effect that he had practically concluded negotiations with the federal authorities by which San Francisco would be enabled to secure possession of the Hetch-Hetchy system. For several years Mr. Phelan has been endeavoring to obtain the water rights for San Francisco. At the meeting of the Water Committee last week it was urged that the city's interest called for the acquisition of the Tuolumne supply, if that were feasible. This decision was reached after Captain Payson, president of the Spring Valley Water Company, had said that his corporation was financially unable to make the improvements necessary to meet the growing demands of the city. It was brought out that the summer months would find the city with an entirely inadequate supply, unless steps were taken at once to remedy matters. Present at the meeting were Capt. Payson, Col. W. H. Heuer, Walter Macarthur, C. H. Bentley, Isidor Jacobs, A. H. Vail, Frank J. Symmes and Michael Casey. The committee was formed primarily to find some means of improving the water supply of the city, either through co-operation with or the purchase of the Spring Valley plant, or the acquisition of some independent source.

OIL.

San Francisco, Cal.—The Southern Pacific is to spend $2,000,000 on a 265-mile oil pipe line from the Kern County oil fields to a point on San Francisco Bay, opposite this city. The line will consist of an 8-inch pipe for the entire distance, and along it there will be twenty-three pumping plants, each with two single or triple-compound duplex oil pumps, and at each pumping plant there will be a 750-horsepower battery of water-tube boilers in three units and two steel tank reservoirs for storage purposes.

Benicia, Cal.—Work on the oil refinery which Los Angeles and San Francisco capitalists are to build on the bay shore, between Vallejo and Benicia, will begin this week. Eighteen boiler makers will arrive from the East to erect the tanks, which will be the preliminary work at the Glen Cove site. David Fleischer, of San Francisco, acting as agent for the oil men, has procured a wharf franchise at that point, and will at once erect a big wharf.

TELEPHONES.

Ketchican, A.—A line between Hadley and Kasaan at Karta bay is planned.

North Yakima, Wash.—This city will soon have a new system, the Independent Telephone Company, Seattle being the applicant for a franchise.

Tacoma, Wash.—The Home Telephone Company will have about 400 phones installed in business houses by June 25th. Residence phones will be put in later.

Ketchican, A.—The Heckman telephone line is being relocated from Ketchikan to Ward's Cove. It is being strung along the beach instead of through the woods.

Aberdeen, Wash.—Council has cited E. P. Finch to appear and state why his franchise to build an independent telephone line should not be revoked and the $500 of bonus money retained.

Ellensburg, Wash.—Farmers' Telephone Company has completed its line to the Badger Pocket country, 17 miles east of here. The line is 35 miles in length and six trunk wires serve the subscribers.

Ilo, Ida.—The Nez Perce Co-operative Telephone Company will improve its lines. The building of an extension from Dublin to Lawter's canyon and the construction of a branch line from Nez Perce was authorized.

Coeur d'Alene, Ida.—The Interstate Telephone Company has just completed the installation of its system. Its board has a capacity for 500 lines, which will be doubled before the close of the year. J. W. Fisher is manager.

Davenport, Wash.—By members of the town council, the application of John Nichols and others for a franchise for a second telephone system was unanimously voted down. The present system, known as the Farm and City Telephone Exchange, is controlled by J. A. Hansen and is given service all over Lincoln and Stevens county.

Pomeroy, Wash.—Arrangements have been completed by the Pacific States Telephone Company for the installation of an automatic system to take the place of the town exchange at Pomeroy. A new switchboard will be put in also, to better accommodate the increasing demand. The town exchange was installed in 1904, when 11 instruments were put in as an experiment. Now there are 200 instruments in use, besides the farmers' line, which utilizes 100 instruments.

Spokane, Wash.—Fifty thousand dollars will be expended by the Home Telephone Company, of Spokane, on a building to be used as a substation. The company will erect two substations and a main exchange, the entire cost being $200,000, exclusive of equipment. John T. Huetter, contractor, has begun work on the foundation for the main exchange, and the structure will be rushed. W. W. Hindman, attorney, who is associated with Cyrus Happy, vice president of the company, announces that 4,000 instruments will be in operation December 1, 1907.

WATERWORKS.

Reno, Nev.—This city is to be supplied with water from Hunter Creek for domestic purposes. Twenty-inch wooden pipe, wrapped with steel cable, is piled along the duct at the west end of the city. The pipe is constructed of redwood and will be laid under ground.

OIL.

Bakersfield, Cal.—The Associated Oil Company is preparing to install a new first class boiler plant at McKittrick.

Bakersfield, Cal.—The Kern River Company is building a new reservoir of about 75,000 barrels capacity and will start drilling soon on the west line. The San Francisco McKittrick Company's wells, which have been closed down for two years, are now being cleaned out, and in about a week pumping will be resumed. A. B. Canfield is preparing to drill on his property at the north end. The wells at Midway will be opened this month.

Coalinga, Cal.—The residents of this place are greatly excited over an oil gusher which has been spouting at the rate of from 500 to 1,000 barrels a day for the last week. The well is owned by the Commercial Petroleum Company, of which M. L. Woy, of Fresno, is a heavy stockholder. Others are M. Madsen and W. W. Machen, of Fresno, Captain Madsen, of San Francisco, and the Associated Oil Company. The well is about four miles west of Coalinga. It is regarded by experts as a record breaker, and means a fortune to each of the lucky stockholders. The oil is of very light weight.

Bakersfield, Cal.—A party of well known residents of this city have acquired possession of eleven acres of valuable oil lands in Western Utah, and have formed the Bakersfield and Utah Oil Company to control the new lands, and will start development work on their property at once. The land is in the new Clear Lake oil fields, in Millard County, in the west-central part of the State, and is considered one of the most promising fields which have been recently discovered. Development work which has been done by "Oil King" Newhouse on adjoining property has proved so promising that he has quietly bought up all other available land in the fields with the exception of that owned by the Bakersfield men. A rig has been sent out and will be set up at once on their property. W. O. La Grange will act as general manager of the company. The other incorporators are F. G. Munzer, J. W. Brisco, W. T. Davis, J. J. Anderson, Geo. A. Damon, W. S. Johnson and J. S. Wildy. The company is capitalized at $500,000.

TRANSMISSION.

Georgetown, Cal.—P. E. Mageistadt passed through this place last week on his way to Rubicon. He is investigating the water flow below the Ralston Bridge with a view to installing an electric power plant at Eagle Bar or near it.

Crescent City, Cal.—The Crescent City Light, Water and Power Company is making preparations to install a plant near the mouth of Craigs Creek, emptying into the south fork of the Smith River several miles above its mouth. A concrete dam will be placed in the creek.

Lakeport, Cal.—Wm. M. Dean, general superintendent of the Snow Mountain Water and Power Company, came over from Ukiah last week to hold a meeting with the local officials of the Lake County Electric Light and Power Company, which is an allied corporation with the big Eel River Power plant. The local men present were H. V. Keeling, W. P. Mariner, M. S. Sayre, B. H. Henderson, and A. H. Spurr. They are holding off their operations until the main company gets the power delivered to the Lake County line. Mr. Dean said that electricity would be available in Lakeport for light, heating and power positively by November.

INCORPORATIONS.

San Francisco, Cal.—The Electrical Repair and Construction Works has been incorporated with a stock of $20,000, by C. R. Frazer, W. G. Lenhart and M. M. Frazer,

Los Angeles, Cal.—The Mission Spring Water Company has been incorporated with a capital stock of $150,000, by Edw. Hunter, E. G. Love, J. S. Gong, R. J. Long and G. L. Mosselle.

Los Angeles, Cal.—The Elysian Garden Water and Supply Company has been incorporated with a capital stock of $50,000, by Edw. Greenfield, J. S. Clark, J. W. Newbern and L. P. Jacquth.

San Francisco, Cal.—The Thirty-Six Oil Company has been incorporated with a capital stock of $100,000, by Mary J. Thomas, Ella M. Goe, C. L. Hovey, A. E. Bolton and W. B. Beaizley.

Los Angeles, Cal.—The Esperanza Petroleum Company has been incorporated with a capital stock of $600,000, by J. F. Goodwin, Henry Werner, F. H. Gates, A. H. Froom and W. W. Dashiel.

Fresno, Cal.—The Blair Oil Company has been incorporated with a capital stock of $250,000, by Scott Blair, S. D. Porter, J. M. Hendrickson and H. C. Kerr, of Coalinga, and J. O. Hickman, of Hanford.

Stockton, Cal.—The Gate City Oil Company has been incorporated with a capital stock of $250,000. Directors: J. W. Mosher, of Sacramento; Ira E. Smith, J. F. Lynch and F. F. Giottonini, of Stockton.

Modesto; Cal.—The La Grange Water and Power Company has had its capital stock increased from 1,000 to 2,000 shares each. Directors: J. P. O'Brien, E. J. Epperson, E. W. Billet, J. W. Lilienthal, Albert Raymond and C. Elkus. Place of business, Goldfield, Nevada.

San Bernardino, Cal.—The Western Power and Water Company has organized and taken over the landholdings of the Poole-Westwater people along the Mojave River. A. F. Poole, Robert Westwater, a Cincinnati capitalist, J. P. Scott and others, are the incorporators. The capital stock is $600,000. It is understood that the Victor reservoir will now be a reality and that power plants, tunnels and other development work will go forward.

Denver, Colo.—Articles of incorporation were filed here June 5th, for the Idaho Nevada Power Company, with a capital stock of $7,500,000. The company has for its directors a number of Colorado Springs men, who are associated with eastern capitalists. Headquarters will be maintained in Denver. This concern, which will operate principally in Idaho and Nevada is to be an auxiliary to the Central Colorado Power Company, recently incorporated in Colorado with a capitalization of $22,000,000. In this concern is Myro Herrick, former Governor of Ohio; Thomas L. Walsh and David H. Moffat, multimillionaires of Colorado, and a number of other prominent capitalists of Colorado and the East.

WATERWORKS.

Gridley, Cal.—At a meeting of the Board of Trustees recently the subject of municipal water works was discussed, and tentative action taken looking to the purchase of pumps, power, and tanks. Estimates of cost were asked for.

Modesto, Cal.—The City Trustees at their last regular meeting decided to accept the proposition of Frank A. Cressey to install the pumping machinery, power, etc., and to pump such water as is needed to keep up the city supply for the consideration of $100 per month. The work of laying the mains to connect with the well will begin at once.

TRANSMISSION.

Los Angeles, Cal.—The Nevada, California, Electric Power Company, the new company which will transmit power to Ely and other mining camps and towns between Nevada, California, and that place, will also build to Ramsey.

Los Angeles, Cal.—An ordinance has been passed granting the Pacific Light and Power Company a franchise to operate and maintain an electric pole and wire system upon all public roads in the County of Los Angeles.

Ukiah, Cal.—Sealed bids will be received by the Board of Trustees up to July 13, 1907, for the purchase of a franchise asked for by the Snow Mountain Water & Power Company, to erect and maintain for the transmission of electricity for heat, power and light and other purposes and telegraph and telephone lines along certain streets and highways in the town of Potter Valley.

Martinez, Cal.—It being proposed to grant a franchise to erect and operate in Contra Costa County all piers, mast poles, etc., upon which to suspend wires, or other appliances for transmitting electricity and to lay cables and other appliances for transmitting electricity for all purposes, the Board of Supervisors will receive written tenders and offers for such franchise, on July 1.

Goldfield, Nev.—The problem for electrical power for Wonder and adjacent camps has been solved after months of hard work on the part of J. D. Jewett, formerly consulting engineer for the S. P. Co. at San Jose, Cal., and G. H. Richardson, of Wonder. Water has been discovered in Bevis and Anderson canyons to furnish 800 horsepower. All that will be necessary will be a dam fifty feet high and thirty feet at base and twenty feet on top.

Downieville, Cal.—Word has reached this place of the destruction of the very expensive electric plant owned by the Four Hills Company, situated in the extreme northern part of Sierra County. Parts of the house were carried down the canyon for half a mile. This was the most complete plant in Sierra County, consisting of two 2,300-volt generators run by water power under 960 feet vertical pressure. The plant was built at an enormous expense, and its loss will be a heavy blow to the Four Hills Company.

Sacramento, Cal.—Col. F. C. Chadbourne and Col. H Banester, of San Francisco, are in Plumas County in the interest of a great power development plant near Quincy. Col. Chadbourne secured the water right in two canyons in Plumas four years ago, with the intention of holding them for ten or a dozen years, when he was convinced that they would become valuable. That time came several years ahead of his anticipations, and he and Col. Banester proposed to begin forthwith building the necessary dams and other structures for the generation of 60,000 horse power. Enormous quantities of cement have been purchased for the undertaking, which will rank the largest electric enterprise in California, save the establishment under construction by the Great Western Power Company, which will supply energy for the operation of the trains of the Western Pacific. Colonel Chadbourne says that his company has orders for all the electricity that it can generate. Colonel Chadbourne verified the stupendous work being done in the way of electrical development by the Western Power Company for the Western Pacific. He says: "It is true that the Gould lines will be operated in California by electricity. While the Western Power Company will have, as you stated, 100,000 horsepower, it will be unequal to demand for power. However, there will be plenty of opportunity for the company to add to its equipment. It is prepared to utilize the additional resources as the occasion requires.